FLOOD TAX FOR THAILAND : THE CASE STUDY OF BANGKOK

Panyapat Anuwatkhunnatham

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Panyapat Anuwatkhunnatham
School of Development Economics

Associate Professor ....Major Advisor
(Udomsak Seenprachawong, Ph.D.)

Associate Professor ....Co-Advisor
(Adis Israngkura, Ph.D.)

Assistant Professor ....Co-Advisor
(Anan Wattanakuljarus, Ph.D.)

The Examining Committee Approved This Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy (Economics).

Associate Professor ....Committee Chairperson
(Orapan Srisawaluk, Ph.D.)

Associate Professor ....Committee
(Adis Israngkura, Ph.D.)

Assistant Professor ....Committee
(Anan Wattanakuljarus, Ph.D.)

Associate Professor ....Committee
(Udomsak Seenprachawong, Ph.D.)

Assistant Professor ....Dean
(Nada Chunsom, D.B.A.)

October 2015

ABSTRACT

Title of Dissertation	Flood Tax in Thailand : The Case Study of Bangkok
Author	Mr. Panyapat Anuwatkhunnatham
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Thailand has been more likely to be effected by catastrophe events especially, flooding because of geographical reason and climate change situation. From flooding event in 2011 in Thailand, according to the World Bank with the confirmation of Thai Government, flooding has affected 3,151,224 people from 1,154,576 families and damage estimated of at least 185 billion baht. Employment has been hurt when factories flooded and workers were laid off or fired. Not all factories are expected to reopen causing significant long term job loss in Central Thailand. Therefore, this study examined the issue of the public support for the provision of " a yearly tax for flood prevention scheme" . This study has estimated how much the public, the general population, would be willing to pay for supporting this particular scheme for the purpose of reducing Government budget deficit in providing national flood prevention project, targeting working population, with a yearly payment as part of their yearly income tax. This scheme would be regarded as public-private good as it would directly reduce the risk of flooding in society, if flooding occurred.

With the use of a single bounded contingent valuation method (CVM) format , a 600 sample surveyed study asked 20-60 years old taxpayers in Thonburi Bangkok to elicit their willingness to pay (WTP) to support this flood prevention scheme with an initial tax payment of either 500, 1,000, 1,500, 2,000 or 2,500 baht respectively. As for the measure of total economic benefit, this study also divided respondents according to geographic characteristics of their living place in order for designing flood tax rate with equity and efficiency manner.

The results of the probit model found that the mean WTP values for a flood prevention scheme were 1,878 baht for those who have lived in low-lying area and

1,464 baht for those who have lived in high area. In addition, personal income and the rate of tax payment were the most influential factors when individuals made their decisions on whether to sponsor this scheme. This study recommends that the Thai government should use a progressive tax with differentiated rate according to geographic characteristic to fund this scheme when a flood prevention program become available.

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ABBREVIATION

Abbreviations	Equivalence
BMA	Bangkok Metropolitan Administration
EGAT	Electric Generation Authority of Thailand
HD	Highways Department
LAO	Local Authority Organization
MD	Marine Department
MI	Ministry of Industry
MOAC	Ministry of Agriculture and Cooperatives
MOD	Ministry of Defence
MOI	Ministry of Interior
MoNRE	Ministry of Natural resources and Environment
MoST	Ministry of Science and Technology
MOT	Ministry of Transportation and Communication
OCS	Office of the Council of the State
OPM	Office of the Prime Minister
OSCWRM	Office of Strategic Committee for Water Resource Management
RRD	Rural Roads Department.
RTSD	Royal Thai Survey Department.
SCRFD	Strategic Committee for Reconstruction and Future Development
SCWRM	Strategic Committee for Water Resource Management
SRT	State Railways of Thailand
TMD	Thai Meteorological Department

CHAPTER 1

INTRODUCTION

1.1 Introduction

1.1.1 Flood Situation in Thailand

Weather-related catastrophe loss has been significant in the last decade, especially, flooding situation in 2011. The persistent monsoonal rains combining with the remnants of a series of tropical flooding in Thailand during the second half of 2011 was enhanced by and likely the result cyclones beginning in late July and lasting through the month of October. More than 884 people were killed and millions of residents were either left homeless or displaced following significant flooding. In total, 65 of Thailand's 77 provinces were impacted during this timeframe and damage was widespread and severe in many locations. Economic losses were estimated by the World Bank at 1.4 trillion baht, which makes the floods one of the top five costliest natural disaster events in modern history.

Some of the likely reasons for the floods included excessive rainfall, urbanization, high tides, insufficient drainage and flood protection systems, subsidence, the possible role of sudden release of waters from upstream dams and the general slope of land. Table 1.1 below shows the 30-year average of rainfall totals for each region, broken down by season.

Table 1.1 Annual Rainfall Averages (in millimeters) for the Region of Thailand

Region	Winter Season (mm)	Summer Season (mm)	Rainy Season (mm)	Annual number of Rainy Days
North	105.5	182.5	952.1	123
Northeast	71.9	24.2	1085.8	117
Central	124.4	187.1	903.3	113
East	187.9	250.9	1417.6	131
South				
1) East Coast	759.3	249.6	707.3	148
2)West Coast	445.9	383.7	1895.7	176

The excessive rainfall that came from the tropical cyclones bought even more water throughout central and northern Thailand, in addition to rainfall from the seasonal monsoon. Table 1.2 provides a sample of three tropical systems that impacted Thailand between June and August 2011, including the recorded rainfall and water runoff in four separate river basins (Ping, Wang, Yom and Nan).

Table 1.2 Water Runoff Volume in Ping, Wang, Yom and Nan River Basin from Storms between June and August 2011

Storm	Duration	Average Rainfall by Basin (mm)				Runoff Volume by Basin (million cubic meters)			
		Ping	Wang	Yom	Nan	Ping	Wang	Yom	Nan
Haima	June 24-26, 2011	64.5	56.5	90.7	234	890	245	870	3,270
Nock-ten	July 30-31, 2011	97.1	117.7	126.2	46.9	1,000	370	900	1,100
Depression	August 18-20, 2011	37.6	24	45	56.2	260	65	325	590
					Totals	2,150	680	2,095	4,960
					Grant Total Runoff		9,885		

For the full year of 2011, every section of Thailand saw an elevated amount of rainfall when compared to the typical 30-year average. The combination of an active monsoon with the remnants of multiple tropical cyclones helped fuel the increase in precipitation during the calendar year in 2011. Figure 1.1 shows the annual rainfall total in 2011 for Thailand, broken down by region and also signifying the percent above normal.

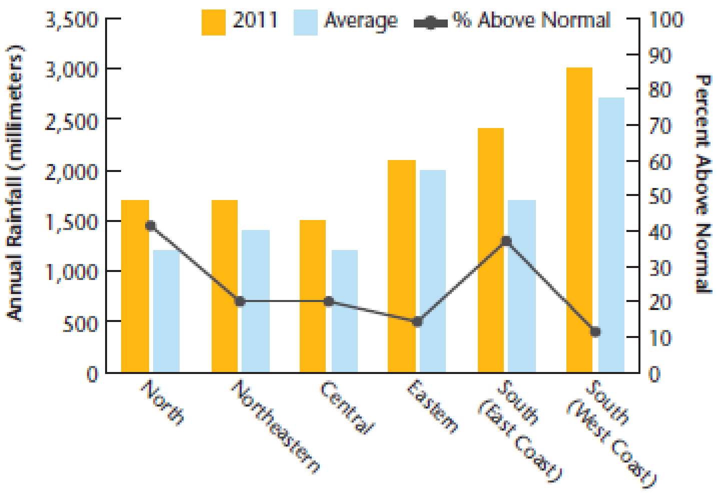

Figure 1.1 Regions of Thailand-Total 2011 Rainfall as Compared to the 30-Year Average

Source: Thai Metrological Department, 2011.

Many of the primary sectors that form the backbone of the Thai economy such as agriculture, manufacturing, tourism and personal property were dealt a severe blow during the flooding in 2011. The loss of production throughout the duration of the floods led to a notable disruption of the global supply chain for major industries such as automobiles and electronics which will take the first half of 2012 for many factories to return to normal production levels.

To provide a historical context, there were several tropical cyclones during a single year in Thailand to affect the country, most notably in 1952, 1964, 1971, 1972 and 1989. However, there are no documented reports of serious flooding during these years that come close to the magnitude of what occurred in 2011. In addition to the excessive rainfall sustained from the heightened tropical cyclone activity and above normal monsoonal activity, the magnitude of the 2011 floods may also be correlated with the increase of construction in some areas during the last several years, inadequate drainage systems and the possible role of release of water from upstream dams. Figure 1.2 provides a glimpse of the number of tropical cyclones which have impacted northern and central Thailand between 1945 and 2011.

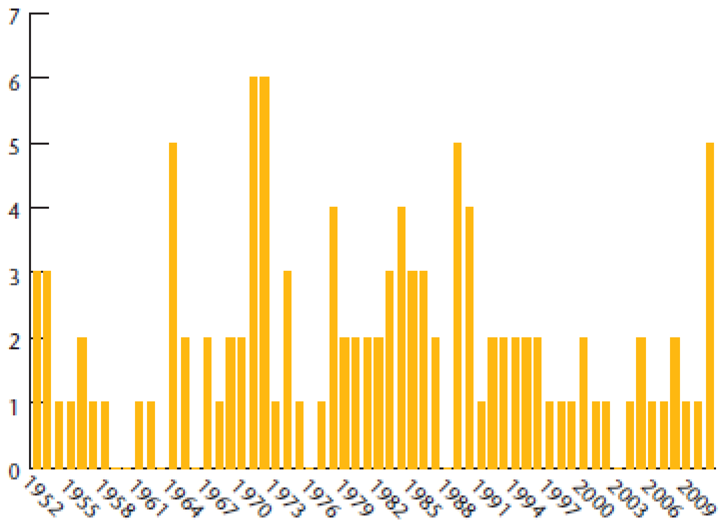

Figure 1.2 Number of Tropical Cyclones Affecting Northern and Central Thailand (1945-2011)

Source: IBTRACS/JTWC, 2011.

1.1.2 Historical Flood Events in the Chao Phraya River Basin

The lower Chao Phraya river basin has endured repeated floods throughout its history, which has prompted residents living along its banks to adapt their lifestyle to these recurring events. In term of discharge, the worst floods in recent history prior to 2011 were documented in 1831, 1942, 1983, 1995, 1996, 2002, and 2006. The combination of rapid urbanization, increased agricultural cultivation in the surrounding areas and a decrease in the level of flood retention has all contributed to the enhancement of these floods. Table 1.3 analyzes historical floods and some of the natural and human factors in the Chao Phraya river basin.

Table 1.3 Historical Analysis

		1942	1983	1995
Human Intervention	Forest Cover[a]	166000 km^2	106000 km^2	92000 km^2
	Area Denuded	N/A	60000 km^2	74000 km^2
	Reservoir Capacity	N/A	23 billion m^3	24 billion m^3
	Flood Protection	2230 km^2	12900 km^2	14400 km^2
	Urban Area[b]	51 km^2	389 km^2	528 km^2
Natural Causes	Rainfall Upstream	Exceptionally heavy	Unusually heavy	Unusually to exceptionally heavy
	Rainfall in Bangkok	Normal	Unusually heavy	Normal to unusually heavy
	Tides	Normal Spring tide with seasonal effects	Normal Spring tide with seasonal effects	Normal Spring tide with seasonal effects

Note: [a] Northern and Central Regions of Thailand
[b] City of Bangkok only

Table 1.4 provides a look at historical economic losses due to flooding along the Chao Phraya river basin between 1978 and 1995. The figures are losses from the time of occurrence and have not been adjusted for inflation or economic growth.

Table 1.4 Flood Management in Chao Phraya River Basin

Year	Economic Cost (THB)	Economic Cost (USD)	Year	Economic Cost (THB)	Economic Cost (USD)
1978	21 million	692,000	1987	833 million	27.5 million
1979	3.2 million	105,000	1988	21 million	692,000
1980	1.55 million	51 million	1989	3.2 million	105,000
1981	314 million	10.4 million	1990	1.55 million	51 million

Table 1.4 (Continued)

Year	Economic Cost (THB)	Economic Cost (USD)	Year	Economic Cost (THB)	Economic Cost (USD)
1982	224 million	7.4 million	1991	314 million	10.4 million
1983	1.1 million	36.3 million	1992	224 million	7.4 million
1984	323 million	10.7 million	1993	2.18 million	71.9 million
1985	350 million	11.5 million	1994	46 million	1.52 million
1986	628 million	20.7 million	1995	11.9 million	392 million

1.1.3 Economic Impacts

According to the World Bank report 2011, total economic losses from the July- December 2011 floods were estimated to be 1.4 trillion baht (USD 45.7 billion). The Thailand government also confirmed these economic losses. In the World Bank report, it was determined that a disproportionately large percentage of the losses (90%) were suffered by the private sector, as opposed to only 6% by the public sector. The other 4% includes combined miscellaneous losses. Table 1.5 below provides a private sector breakdown of losses as estimated by the World Bank.

Table 1.5 Breakdown of Economic Losses

Sector	Economic loss (Billion THB)	Comments
Manufacturing	1,007	Most losses sustained at industrial factories
Tourism	95	Loss of tourism revenues over a 6-month span
Households/Personal Property	84	Includes structural and indoor content losses
Agriculture	40	Loss of agricultural production

Source: World Bank Report, 2011.

In term of economic costs incurred by households in the 2011 Bangkok flood estimated by World Bank, it was reported that the mean household damages in Bangkok, Nonthaburi and Pathum Thani provinces were USD 1,310 USD 1,409 and USD 1,532 respectively. In contrary with a study done Orapan, Hermi and Aini (2014), it was found that the mean households damages in Bangkok, Nonthaburi and, Pathum Thani provices were USD 6,598 USD 5,937 and USD 3,531 respectively which were approximately 2-5 times higher than the estimates of the World Bank (2011). This is due to two reasons. First, Orapan, Hermi and Aini (2014) included cost components that were not included in the World Bank study which were both direct and indirect costs before, during, and after the flood while the World Bank estimated housing damage based on the number of dwellings that were likely inundated, based on flood maps. From the results of Orapan, Hermi and Aini (2014) study, it revealed that about 5% of the total household economic costs were incurred before the flood, 27% during the flood, and 66% after the flood which pointed the need for government policy to focus on the importance of evaluating alternative policies to reduce households' ex post economic costs.

The overall Thai economy sustained a much greater impact than was initially expected. According to the Fiscal Policy Office (FPO), the Gross Domestic Product (GDP) was expected to grow only by 1.1% for the calendar year 2011. This was well below the pre-flood projection of 4.5% growth and a revised 'worst-case' projection of an annual 1.7% growth as the floods were at its peak.

During the first three quarters of 2011, the Thai economy reports a 3.1% growth. However, the fourth quarter was very challenging as the floods had disrupted exports particularly the farming and manufacturing sectors, which led to the economy shrinking. The GDP declined by 9% in the last quarter of 2011 compared to a year earlier, according to the National Economic and Social Development Board (NESDB). Moreover, at the time of flooding period, GDP would temporarily increase by some reasons such as the purchase of sandbags or any materials to protect individuals' living places. However, for welfare economic point of view, the temporary increase in GDP for this reason is considered as negatively undesirable outcome because it actually does not reflect in the real production or consumption.

1.2 Background and Rational

Major floods are occurring during the 2011 monsoon season in Thailand, and continuing for over three months. It has been described as "the worst flooding yet in terms of the amount of water and people affected”.

As of 6 November 2011, flooding has affected 3,151,224 people from 1,154,576 families, with 506 deaths and 2 missing persons reported by the 24/7 Emergency Operation Center for Flood, Storm and Landslide (EOC). Damage estimates of at least 185 billion Baht by the latest estimation by Federation of Thai Industry (Central region section) which includes 95 billion Baht damage on Thai industry, 25 billion Baht damage on Thai Agriculture and 65 billion Baht damage on the housing in the communities and suburb villages. A large part of the damage stems from the effect on the manufacturing industry, with 930 factories in 28 provinces affected, including multiple industrial estates in Ayutthaya and Pathum Thani Provinces which have been flooded. The flooding has been estimated to result in decrease 0.6 to 0.9 percent in economic growth. Schools, 1,053 of which have been affected as of 19 September 2011, were forced to end the term early.

Employment has been hurt when factories flooded and workers were laid off or fired. Not all factories are expected to reopen causing significant long term job loss in Central Thailand.Thailand accounts for about 30 percent of global trade in rice and 25 percent of the main crop is not expected to survive being flooded. Moreover, floods cause social disruptions and result in scarcity of drinking water as surface water gets contaminated by organic and inorganic substances. Case of diarrhea, cholera and other intestines also increase remarkably during and after floods. It also cause environmental problem which results in uncontrollably making water get contaminated by harmful substances released by agricultural and industrial sector before flowing to the gulf of Thailand and finally the sea that will make the number of marine organism such as commercial fish die and is not suitable for consumption. Moreover, after flooding relieved, a huge amount of money will be spent not only for household, business and agricultural sectors in repairing private property but also the government to give compensation to those sectors and repairing public infrastructure such as road etc as well.

A report published by the United Nations says that flooding in Bangkok is likely to get so severe by the middle of this century that parts of the Thai capital may have to be abandoned. Subsidence and poor urban planning have resulted in Bangkok gradually sinking between 2 cm and 5 cm a year. Unless radical action is taken soon, experts say Bangkok will be underwater in less than 50 years.

It's well known by city residents that Bangkok is sinking, with experts first documenting the problem in the early 1980s. But now scientists say there are added factors that are fast-tracking the city's immersion. Much of the problem was caused by water for industry being extracted from underground aquifers faster than it could be replaced, causing the soil to compress. Another issue is that many of Bangkok's canals, which once drew comparisons with those of Venice, have been concreted over and turned into roads, while houses and factories have been built on the natural floodplains surrounding the capital.

1.2.1 Flood Management: Structural and Nonstructural Measures

Flood management is a broad spectrum of water resource activities aimed at reducing potential harmful impact of floods on people, environment and economy of the region. The resulting benefits of flood control management are both direct and indirect. Direct benefits are those that accrue directly to a given individual or group, in contrast, indirect benefits are experienced by the entire community. Specifically, given the spatial nature of these benefits, some direct benefits can accrue to a subset of the population. For example, if a project reduces the probability of flooding, those residents living in the floodplain areas will be expected to experience less flooding and hence experience direct benefits. Publicly provided goods (e.g., roads, public buildings, etc.) are also less likely to be damaged. However, there are also indirect benefits to the wilder community emanating from flood control projects. Indirect benefits may be commercial (e.g., businesses avoiding passing on increased costs due to flooding to their consumer) or they may be altruistic (sense of "doing the right thing" for the whole community, valuing the environment, etc.).

Structural measures or engineering interventions are designed to keep floodwaters away from people. Technically speaking, there is no flood risk that can not be mitigated by structural or engineering measures; however, the cost may be prohibitive. On the other hand, nonstructurals measures aim to keep people away from flood waters or to teach them to live rationally amid the threats of flooding through prudent land management and disaster preparedness. If structural measures are the bones of a flood management program, nonstructural mitigation is considered as its flesh (United Nations Educational Scientific and Cultural Organization, 2001). Implementation of flood management measures contributes to a government's fiscal burden. With the increasing frequency of flood disasters, the cost of disaster prevention, relief, and reconstruction, including the consequent economic losses of flooding have grown concomitantly. This increase in fiscal burden has become the foremost incentive for governments to consider in design the effective system, which entail a cost-sharing arrangement among relevant stakeholders and government in such a way that those who are beneficial to flood project can share responsibility, hence to reduce government fiscal burden, to solve this problem.

According to the World Bank, floods are the most frequently occurring form of natural disaster in East Asia, South Asia and the Pacific. In the past 30 years, about 40 percent of flooding world-wide occurred in Asia. More than 90 percent of the global population exposed to flooding lives in Asia.

Meanwhile, the urban population of East Asia will have doubled from the 1994 by 2025. The fastest rates of urbanisation are taking place in China and Southeast Asia, with cities in this region expanding at rates five times faster than those in the Organisation for European Economic Co-operation.

Urban flooding is becoming more costly and more difficult to manage as low and middle-income countries in the region transition to largely urban societies, with greater concentration of people and assets in cities and towns. Losses can reach beyond the edge of actual floodwaters, as the impact on industrial supply chains during the 2011 floods in Thailand demonstrated. Urban expansion often creates poorer neighbourhoods which lack adequate infrastructure and services, making them more vulnerable to floods. As developing countries in the region transition to largely urban societies, the concentration of people and assets has made urban flooding increasingly costly and difficult to manage. In addition to direct economic damage, floods also have long-term consequences such as loss of education opportunities, disease and reduced nutrition which may erode development goals.Therefore, a clear plan from the government on preventing further flood damage could boost confidence among investors.

The need to reduce flood risk in urban area by applying not only “hard” or “structural” measures, such as building drainage cannel of floodways, but also “soft” or “non-structural” ones such as early-warning systems, insurance and measures to heighten awareness of flood risk is thus wildly accepted. Therefore, it needs to be stressed that only a best mix of the strategies presented in table 1.6 adjust to the particular circumstances of each river basin can serve the aims of integrated flood management.

Table 1.6 Strategies and Options for Flood Management

Strategy	**Options**
Reducing Flooding	Dam and reservoirs
	Dikes, levees, and flood embankments
	High flow diversions
	Catchments management
	Channel improvements
Reducing Susceptibility to Damage	Flood plain regulation
	Development and redevelopment policies
	Design and location of facilities
	Housing and building codes
	Flood-proofing
	Flood forecasting and warning
Mitigating the impacts of flooding	Information and education
	Disaster preparedness
	Post flood recovery
	Flood insurance
Preserving the natural resources of flood plains	Floodplain zoning and regulation

Source: World Meteorological Organization, 2004.

1.2.2 Structural Measures

The examples of “hard” or “structural” measures of flood management are as follows:

1.2.2.1 Forest Rehabilitation at the Head of Watershed

This involves reforestation at the head of the watershed area and weir construction to slow down the flow of water into the city.

1.2.2.2 Reducing the Water Flow in the River

These include constructing more retention ponds and building more reservoirs. These measures can reduce the volume of water that flows through the city. However, people in the upper river watershed, which is the chosen area for the construction of retention ponds, are against this measure since their houses and farms might get flooded and they do not want to reallocate to other areas. In addition, the affected people will not get any benefit from the project. The option to use agriculture land for the storage of floodwaters would require “proper compensation schemes”

1.2.2.3 Drainage System Improvement

First, reducing drainage congestion by removing floating rubbish, trash, water hyacinth and other that block the flow of water, digging up or removing mud from canal or small waterways every three month, especially before the raining season is coming. It also includes annually repair and maintenance of the function of sluice gates to make it function normally to control water level.

Second, increasing capacity of drainage basin by constructing additional floodway directly to the sea in order to short cut water drainage and installing additional water pump for the purpose of increasing drainage system are considered as drainage system improvement. During floods, water pumping machines are set up in several areas and divert it to rivers or canals.

Even though dredging the river to lower the river bed can help the water flow faster, it can negatively impact the ecosystem of the river, for example, it can affect the movement of sediments in the river and contribute to channel instability. Moreover, flora and fauna habitats along the river banks can be destroyed; and if dredging is carried out when there are low water levels in the dry season, it will cause the groundwater table to be lowered.

In the contrary, some measures will give the indirect benefit by making some areas to be more attractive for recreation purpose and increases floodplain fishery and also reduce water get contaminated by harmful substances released by agricultural and industrial sector before flowing to the gulf of Thailand and finally the sea that affect marine animals. However, stagnant water inside this freshwater polder has induced a number of environmental problems such as poor sanitation, waterborne disease and an increase mosquito.

1.2.2.4 Effective Measure for Regulating Flood Levels

By controlling and regulating water level in dam not only for the purpose of agriculture but also for flood prevention. This measure will reduce the frequency of rice farming each year. Since, the dam is also used for irrigation purposes, the authorities have to find a balance between reserving enough water for irrigation and keeping the level low enough to allow for the extra volume during the rainy season so as to avoid flooding.

1.2.2.5 Building Bank Revetments along the River

Bank revetments are usually built as concrete structures to prevent bank erosion and flooding. However, building revetments could damage and degrade the landscape of the river and destroy the in-stream habitats of natural flora and fauna. However, no one knows what the highest water level will be and that the government is relying on past statistics, but there is no guarantee of future maximum water levels.

1.2.3 Non-structure Measures

The examples of “soft” or “non-structural” measures of flood management are as follows

1.2.3.1 Flood Warning System

Another important role of flood management is the establishment of the flood warning system. The flood warning system comprises several components and activities as described below.

1) Flood Risk Map

The flood map displays the severity of floods, illustrated by different colors, with respect to the water level of river. This map indicates the level of risk of flooding in the different areas, where lower numbers indicate higher risks. This flood map has been used by the municipality to implement flood preparation/ protection measures as well as to decide where to provide assistance first. It has also been disseminated to residents to raise their awareness about their exposure to floods.

2) Early Warning System

With the current technology available, so we can predict a flood before it hits the city about seven hours before time. When the hydrological monitoring stations show that the river level has exceeded the critical limit, then the municipality and other relevant government units will inform the residents to prepare for the flood.

3) Flood Information Dissemination

The real-time water level data is measured at the hydrological monitoring stations. Also other information related to impending floods is regularly uploaded onto the website for public access. In addition, during the flood season, a call center is set up for inquiries about the flood situation. Flood warning information is also disseminated in the form of brochures in Thai and English. In addition, the government regularly conducts training on basic knowledge of floods and early warning systems to various sectors of the public like students, government officers, and academics.

1.2.3.2 Reducing/Preventing River Encroachment by Negotiating with the Encroachers

The government has tried to solve the problem of encroachment of the river. However, some encroachers from both the private and public sectors have not cooperated with the municipality. The plan is to use negotiation first, and if this does not work, then to resort to legal action.

1.2.3.3 Financial Relief Measures

There are three kinds of financial relief measures to help people away from financial crisis from flooding implemented in different countries.

First, government compensation is the monetary compensation provided by government to the flood victims. The monetary compensation is typically come from tax revenue.

Second, Flood Insurance is a system of protection against loss from flooding, a person pays money every month or year (premiums) for a guarantee that the company will pay them money if they or their property is damaged or lost .It is a risk- sharing due to the ability of insurance to spread the risk on a wide enough population to absorb the potential catastrophic nature of the hazard.

Lastly, revenue from flood tax, flood tax is the system of protection against loss from flooding by collecting money in term of tax from the beneficiary (those who are beneficial from hard measure projects to protect some particular areas) and paying to the non-beneficiary (those who suffer from flooding because of hard measure projects to protect some particular areas). Generally, this tax can also be used for flood prevention project support including dam construction and maintenance every year for example.

Beside 'hard' physical infrastructure and technology, 'soft' approaches such as financial relief measures especially financial relief measures are increasingly considered as a complementary flood catastrophe adaptation and mitigation mechanism. In addition, experts have stressed that structural or hard measures cannot be the sole method of flood protection, so the authorities should pay attention to alternative soft measures as well.

Therefore, from economic point of view, flood control management should be considered as "positively public services" that almost all people can join the direct or indirect benefits from those measures when the rainy season has come which is the main reason that most beneficiaries should be responsible for in exchange for security from flooding.

Table 1.7 Summary of Measures to Mitigate Floods

Measures	Type of adaptation
1. Forest rehabilitation	Others
2. Early warning system improvement	Technology
3. Reducing the water flow by	Structural
1) Dredging the river	
2) Constructing more retention ponds	
3) Building more reservoirs	
4. Drainage system improvement	Structural
1) Building new water gates	
2) Dredging the river to lower the river bed	

Table 1.7 (Continued)

Measures	Type of adaptation
5. Building river revetments along the river	Structural
6. Reducing/preventing river encroachment by negotiations between the encroaches and authorities	Others

1.2.4 Issues and Significance of the Ploblem

Perennial flooding has resulted in human casualties, damage to properties, and disruption of economic activities in the affected area. Floods exacerbate poverty since the impact of flooding falls disproportionately on the poor. Countries have adopted structural and nonstructural measures as flood management tools to address flooding and its associated risks. Structural measures include engineering interventions, such as construction of dam and dikes, river levees and embankments, rive diversion, widening and deepening of river beds, and setting up of flood detention basins. On the other hand, nonstructural measures consist of financial relief measures, flood forecasting and warning system, restriction development planning, water proofing, and other non-engineering actions.

Based on to the statistical data in the past 10 years, the risk of catastrophic event occurring in the urban areas has been significantly and seriously increasing overtime, especially in the proportion with more 60 percentages occurring in the urban areas of developing countries. While, Bangkok has been ranked to be the seventh from the twentieth countries, and to be more likely facing the catastrophic events including flood disaster and to be the tenth capital countries to suffer economic losses from catastrophic events.

However, according to flood disaster occurring in 2011, it was evidently reflected that Thailand has not had the effective fiscal mechanisms to support future flood prevention investment including to especially compensate money to flood victim in term of complex procedure, efficiency and equity manner for solidarity propose.

Theoretically, source of revenue for flood prevention program and compensation can be coming from three sources which are;

1.2.4.1 Government Budget for Flood Prevention Investment and Flood Compensation

From flood disaster in 2011, apart from water management scheme the government has to undertake for flood prevention in the future, government compensation for disaster losses including flood damages in Thailand is also arranged so that the cabinet has agreed to pay 5,000 baht compensation to each flood-victim's family. Thailand's flood victims will only get compensation in cases where homes have been inundated for more than a week or where flash floods have damaged properties. Additional financial aids will be provided to the flood-hit households as follows: a maximum of 30,000 baht payout for homes that have been completely damaged by the floods and 20,000 baht will be paid out for homes that suffered partial damages. Meanwhile, 25,000 baht compensation will be paid out to victims who died in the floods. The deceased is the breadwinner of the family; the family will be eligible for additional 25,000 baht compensation.

Traditional responses to flooding problems (flood prevention, disaster relief, reconstruction including a hugh amount of compensation) have been constrained by the governments' generally weak fiscal position. Consequently, the potential economic losses and government spending for flood management and compensation increases. Moreover, identification of beneficiaries of flood management measure is difficult and even when the beneficiaries are identifiable; there is rarely any effective redistributive mechanism that allows for beneficiaries to compensate the population who suffer from flooding.

1.2.4.2 Flood Insurance

Flood Insurance is a system of protection against loss from flooding, a person pays money every month or year (premiums) for a guarantee that the company will pay them money if they or their property is damaged or lost. The advantages of flood insurance can be useful in efficiently spreading of risks, enhance household's financial security, and provide incentives to policyholders to limit flood damage. It is a risk- sharing due to the ability of insurance to spread the risk on a wide enough population to absorb the potential catastrophic nature of the hazard. Flood insurance can also provide incentives for individuals to limit losses by, for example, excluding coverage for damage from carpet or wooden floors, which stimulate the use of tile floors or water resistant timber floors. Another strategy to reduce flood losses and claims for insurance companies is to inform policy holders about flood-adapted building use and materials, as well as damage reducing measures that individuals can undertake once a flood occurs (Thieken et al., 2006).

1.2.4.3 Revenue Obtained from Flood Tax

Flood tax is the system of protection against loss from flooding by collecting money in term of flood tax from the beneficial (those who are beneficial from hard measure projects to protect some particular areas) and paying to the non-beneficial (those who suffer from flooding because of hard measure projects to protect some particular areas). This tax can also be used for flood prevention project support including dam construction and maintenance every year for example. The idea of the flood tax is based on flooding event that is the unexpected event and, at least for the short period of time, difficult for prevention. Moreover, the damage from flooding effect the number of people, therefore, the recovery from flooding should be joined together by those people who will be responsible for this risk to be beneficial to the whole country. Moreover, from economic point of view, flood control management, implemented by Thai government as water management action plan should be considered as “positively public services” such that all people can join the direct or indirect benefits from those measures when the rainy season has come which is the main reason that most beneficiaries should be responsible to pay for flood tax in exchange from security from flooding for solidarity purpose.

The benefits of flood tax over the flood compensation by government, and flood insurance is that it can reduce budget deficit from flood control project by taking the moneys from the beneficiaries who can benefit from flood control project and paying them to the non-beneficiaries. Flood tax can also stimulate the incentive to create loss-reducing behavior like flood insurance by using differentiate flood tax rate scheme according to geographic characteristic of each particular area in such a way that, the areas situated in the flood prone areas such as near the liver or in the low area are more likely to pay the higher tax rate than the areas that are situated very far away from river or in the high area. From the economic point of view, if those people benefit of such flood tax must exceed the cost, they will pay the flood tax in exchange for security from flooding; otherwise they would not be undertaken, by having an incentive to move their house to the flood resistant area in order to pay the lower tax rate. Therefore, from the flood tax principle, it encourages some people to greater rebuild their home in environmentally flood resistant areas, thereby finally reducing the magnitude of the resulting losses from flooding. In addition, purchase of flood insurance in household sector is currently not marketable well because of either low probability of flood occurrence or low perceived flood risk of people that is why flood tax initiation is quite more suitable in the Thai context.

1.3 Objective and Research Questions

Policy responses to the increased frequency of extreme weather events can take a number of forms. The government can seek to invest in flood-protection infrastructure and the renewal of urban drainage systems. However, these may often be limited in the degree to which they can offer protection. In addition traditional responses to flooding problems, which normally is command and control mechanism, (flood prevention construction, disaster relief, including a hugh amount of compensation) have been constrained by the governments' generally weak fiscal position. Consequently, the potential economic losses and government spending for flood management and compensation increases, then reduce public investment in other areas. In that case, implementation of flood management measures contributes to a government's fiscal burden, especially hard measure in which its cost may be prohibitive.

Due to the need to explore alternative flood management schemes with market based mechanism and the suitable context-specificity of flooding, country-specific design and testing of feasible flood tax is deemed necessary which can provide the mechanism for transferring benefits from non-affected beneficiaries to affected individuals. However, using flood tax to mitigate natural disasters and reduce financial burden to flood victims are not an easy task. First, individuals may prefer to rely on post disaster assistance from governments or nongovernmental organization (NGOs) rather than paying flood tax in exchange for protecting themselves against the consequences of natural hazard by flood mitigation projects. Second, property owners may not be willing to pay flood tax because they underestimate their true loss probability. Third, lower income consumers have difficulty affording flood tax, and of course this obstacle is particularly important in developing countries. Moreover, a few economic issues and challenges need to be carefully considered in the design and adaptation of flood tax. The objective of this study was to obtain in depth information from the public, the general population residing in Bangkok where one suffered from flooding in 2011 while another one is not, on how much they would be willing to pay for flood tax in order to reduce government budget spending by government solely investment on flood control project. On this account, this study used single-bounded CVM format and preventive expenditure approach to elicit the maximum willingness to pay amount for flood tax in exchange for security from flooding via flood control project. This study would also find out the factors influencing individuals regarding their values toward their willingness to pay amounts on flood tax. Therefore, a thorough understanding of the effects of climate change, geographic and socio-economic variables on the flood tax is important for government in order to design the flood tax for better land management and with efficiency and equity manner. In this study, the research questions are;

1) What are the key factors influencing an individual's payment for flood tax scheme and cost of prevention expenditure for flood prevention in order for designing the suitable policy recommendation for flood tax scheme with efficiency and equity manner for better land-use management by examining how WTP relates to actual risks derived from geographic characteristics? It involves analysis of the factors determining and influencing the level of household's willingness to pay for improved flood control as well as the level of the individual preventive expenditures undertaken by the households to prevent/reduce flood risk from catastrophic event. Moreover, the study provides insight into risk characteristics of individuals who are faced with climate risks, which in turn allows for correct prediction of behavioral responses to risk related to climate change and flooding.

2) How much would individual be willing to pay from the flood tax by using contingent valuation and preventive expenditure approach to investigate the possibility of collecting tax in order for the government to design flood tax with

efficiency, equity manner and therefore reduce the fiscal burden of government budget? This study also compare willingness to pay estimates obtained by mean of two different evaluation techniques: actual preventive expenditures and hypothetical willingness to pay for flood control improvement for consistency approach.

Therefore, in this study, it provides insight into the opportunities for government for the possibility and to what extent willingness to pay to collect flood tax at reasonable rate instead of using the whole government revenue for flood prevention scheme in order to reduce the budget constraint. Moreover, the study provides insight into risk characteristics of individuals who are faced with climate risks, which in turn allows for correct prediction of behavioral responses to risk related to climate change and flooding. Bid function will be estimated to identify factors behind WTP using as explanatory variables perception of flood risk, actual measure of flood risk, estimate of individual risk aversion, and socio-economic characteristics.

1.4 Scope of the Study

1.4.1 Population

As for population, this study defined the target population as only respondents who have resided and worked in Bangkok considered as beneficiaries for the master plan on flood control projects. Member of households who had worked aged between 20-60 years old are designated as respondents because of their decision-making roles in the households, which should make them aware of household finances and what the household could afford to pay for the flood tax.

1.4.2 Location

As has been said, this study was conducted in Bangkok metropolitan area, the capital city of Thailand, Bangkok is likely vulnerable to flooding because majority of Bangkok area is lower than the sea level. Moreover, especially form flood control project, it is aiming to protect such main economic areas for example Bangkok. Therefore, Bangkok is considered as beneficiaries from flooding because of such projects. In total around 600 members of household were interviewed sampling from two zones composing 6 districts situated in Bangkok where one is affected by flood disaster in 2011 and another is not affected by flood disaster in 2011, in order to estimate the population's mean aggregate WTP for flood tax in exchange for maintenance of status quo flooding risk by flood prevention project implemented by government.

1.4.3 The Estimation of Willingness to Pay (WTP)

This study with the use of contingent valuation method and preventive expenditure approach were designed to estimate the willingness to pay (WTP) amount for flood tax. The valuation of the flood tax proposed in this study depends upon each household's subjective assessment of the flooding risk, which in turn depends on proximity to the river, location in the flood plain, and other factors. It also depends on the extent to which the flooding will impact that risk as well as local resident's perception of that risk. Moreover, the context of decision making under uncertainty is maintained as individual (households) are assumed to form subjective judgments over future flood event and flood consequences. Therefore, the household's utility is conditional upon expected events related to flooding, as well as price level, income, and general economic conditions. Consequently, the WTP decision represents an investment in flood tax with the expectation of receiving a security form flooding by such flood control project proposed by the government.

1.4.4 Determinants

The determinants on demand for flood tax scheme, whether respondents as parts of the general population are willing to pay through flood tax, were the expected loss in the event of flood (L); the perceived likelihood of risk of flooding (I), the households wealth level (W); level of households risk aversion (R); geographic characteristics (G) and respondent characteristics such as age, gender, marital status, occupation and education level.

1.5 Significant of Study

Until the present, no studies of flood tax at national level have been done in Thailand using willingness to pay and preventive expenditure approaches. Our study had initiated this method to estimate and investigate the general population's ability to willingly pay for security from flooding because of the flood control project in exchange for paying the flood tax to compensate non-beneficiaries areas and also to support flood control project initiated by government. Second, bid function will be estimated to identify factors behind WTP using as explanatory variables perception of flood risk, actual measure of flood risk based on geographic characteristics, estimates of individual risk aversion, and socioeconomic characteristic on demand for flood tax in exchange for security for flooding. Moreover, the effects of flooding and socio-economic developments on the demand for flood control projects will be assessed. This provide insights into the risk characteristics of individual faced with flooding risk, which allows for accurately prediction of behavioral responses to risk related to flooding.

1.6 Organization of the Study

The rest of this paper is organized as follows: Chapter 2 reviews the previous studies regarding the willingness to pay for flood tax in exchange for security from flooding; Chapter 3 states our theoretical concepts, methodological issues, and modeling analysis; Chapter 4 examines the empirical results; and Chapter 5 draws some conclusions from our results on the flood tax scheme, discuss methodology issues and suggest possible policies based on our findings; and the last section lists the references and provides the appendice.

CHAPTER 2

LITERATURE REVIEWS

2.1 Flood Damage

Floods are the most frequent and devastating of natural disasters that have occurred worldwide during the past century. The number of reported natural disasters in the world reached 9,632 during the period 1905-2004, which floods accounting for about 28% of the total. Damage to infrastructure, crops, housing, etc. have been placed at hundreds of billions of dollars, accounting about 40% of the economic damage brought about by all types of natural disasters. Millions of lives are lost in the process. As business operations are disrupted and decreased earnings are translated into lower tax revenue collections, social programs also suffer because tax money spent on relief and recovery efforts crowd out expenditures intended for health and education. Flood disasters also indirectly cause transportation delays, spread of diseases, power outages and water contamination Asian Disaster Reduction Center (ADRC), 2002 and Myers, 1997).

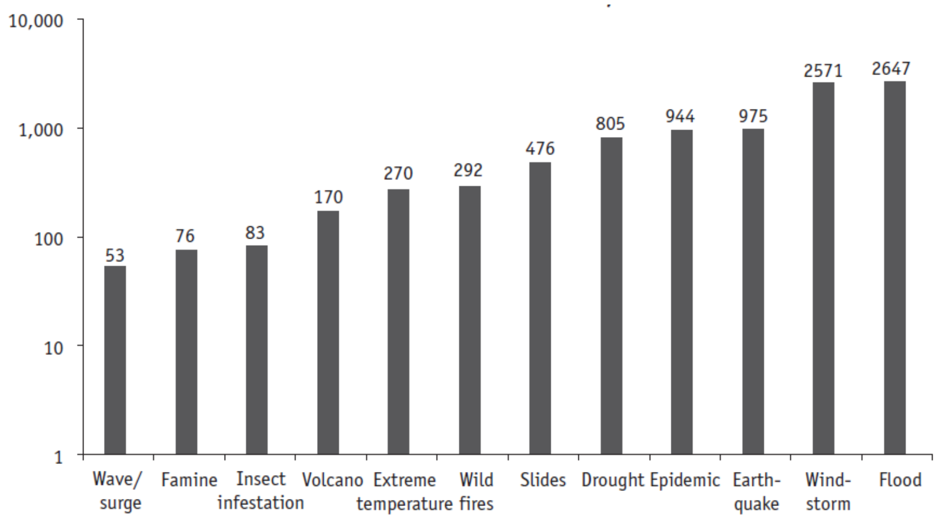

Figure 2.1 Number of Natural Disasters Worldwide, 1905-2004

Research confirms that climate change, at least partly, associated with an increased frequency or intensity of certain weather extremes that has been observed in the last decades, such as heat waves, extreme precipitation, and tropical cyclones.

Table 2.1 Risk Arrangement of the Main Weather Change

Weather event	Climate change	Potential damage	Main damage category
River flood	Increase in risk	Large-very large	Motor vehicles
			Other property
Strom surge	Increase in risk	Very large	Property
Wind storm	Uncertain	Large-very large	Motor vehicles
			Property households
			Property businesses
Extreme drought	Increase in risk	Medium-large	Crop losses
			Waterway transport

Flood damage is defined as damage caused by the failure of primary dikes or dams that protect areas from flooding of main rivers or lakes, which may be caused by extremely high water discharges, extreme drought that weakens dikes, or technical and human failures. Moreover, the potentially largest flood damage can be caused by flooding from the sea due to failures of coastal defenses during storm surge.

The frequency and severity of extreme weather events is likely to increase due to climate change, which is expected to increased economic losses caused by natural disasters. A considerable rise in damage caused by extreme weather can already be observed in the last decades. This rise in historical economic losses has been mainly caused by socioeconomic developments, such as increases in wealth and economic growth in vulnerable areas. In the future, the combination of societal change and climate change is expected to accelerate upward trends in economic losses due to extreme weather events.

Table 2.2 Flood Catastrophe Losses per Decade between 1989 and 2010 in Million Baht in Thailand

Decade	1989-1993	1994-1998	1999-2003	2004-2010
Number of events	54	48	57	61
Economic losses	30	24	30	47

Source: Department of Disaster Prevention and Mitigation**,** 2010.

2.2 Water Resource Management in Thailand

The Chao Phraya River Basin Area consists of eight river basins including Ping, Wang, Yom, Nan, Chao Phraya, Sakaekrung, Pa Sak and Tha Chin, covering the area of 157,925 sq km. The population in this area is around 25 million people. The average annual rainfall is 1,300 mm while the average annual runoff is 33,123 million cu m. The major rivers in this river basin are Ping, Wang, Yom, Nan, Mae Klong, Pa Sak, and Tah Chin. In the northern part of the basin, the entire storage capacity is around 25,773 million cu m., while the central area can store water only 2,124 million cu m. The Chao Phraya River will not overflow as long as the speed of the water flow is not higher than 3,500 cu m. per second.

Water resource is vital for human living, and is essential in sustaining the environment. In recent years, Thailand has experienced frequent and severe drought and flood, which seems to continuously intensify. These extreme events have caused loss and damage to the economy by affecting agriculture, industry and community areas, with an estimation of 10 billion baht. Particularly, the great flood in 2011 has affected not only domestic, but also foreign investment. Assessed by the World Bank, the damages and losses from the 2011 flood is approximately 1.44 trillion baht.

Fully aware of the significant impacts from those floods, the government has set up the Strategic Committee for Water Resource Management (SCWRM). Later on, the SCWRM has formulated the Master Plan on Sustainable Water Resource Management for both urgent and long term, in order to ensure the continuity of country's development even with future drought and flood. The SCWRM has adopted the King's initiatives and the Philosophy of Sufficiency Economy as guiding principles in drafting the Master Plan.

The main weakness and problems of water resource management in the past include 1) the degradation of watershed areas due to illegal encroachment, 2) the incompetent management of water resource and the lack of a single-commanded authority, 3) the lack of a master plan on long-term water resource management, resulting in unclear direction and continuity in budgeting support, 4) the unsystematic and outdated database, and 5) the obsolete laws and regulations relating to water resources.

The overall water resource management should be implemented at the river basin level and cover all river basins countrywide from the upstream, midstream to downstream. The management should ensure the participation of all stakeholders. The water resource management plan should be formulated for both urgent and the long-term periods in response to possible future floods. The concept of water resource management is customized to fit with each area. In the upstream area, the emphasis is on retention flood water and preventing severe runoff. In the midstream area, the focus is on water management in conjunction with water gate control and water drainage to minimize damages from flood. Finally, the downstream, the highlight is on the fast drainage of water to the sea.

The objectives of this plan are to 1) Prevent and minimize losses and damages from medium-to large scale flood, 2) Improve the capacity of flood prevention system, urgency flood management, and increase capacity in the warning system, 3) Build confidence and stability and increase farmer, community, and national income while managing water, land and forest for sustainable utilization with targeting 1) Short term: Reduction of losses and damages from the possible flood in 2012; 2) Long term: Reformation of the flood management system aiming at integrated and sustainable manners.

2.2.1 The Master Plan

The master plan composed 8 work plans and implements guidelines as follows:

2.2.1.1 Work Plan for Restoration and Conservation of Forest and Ecosystem

Work Plan for Restoration and Conservation of Forest and Ecosystem aiming to restore watershed forest where water is retained, to develop additional water reservoirs according to the capacity of the areas and to develop land usage plans, that fit with its local and socio-geographical conditions by restoring and conserving the degraded watershed areas, developing projects for soil and water conservation by promoting economic and community afforestation while rehabilitating mangrove forest, improving water and land usage, increasing storage capacity, and revising and drafting relevant laws.

2.2.1.2 Work Plan for Management of Major Water Reservoirs and Formulation of the National Annual Water Management Plan

Work Plan for Management of Major Water Reservoirs and Formulation of the National Annual Water Management Plan aiming to prevent and alleviate impacts from possible floods in the future by developing water management plans of major dams and river basins, formulating water management plans under different scenarios, improving the Rule Curve in water management that balance water use in several sectors, and presenting water related information to the public.

2.2.1.3 Work Plan for Restoration and Efficiency Improvement of Current and Planned Physical Structures

Work Plan for Restoration and Efficiency Improvement of Current and Planned Physical Structures aiming to prevent and mitigate the impact of flood by implementing 4 sub-work plans including 1) renovating dikes, water control buildings, and water drainage systems to ensure effectiveness in every areas, 2) improving drainage water ways, dredging canals, removing barriers in canals and draining water ways, 3) increasing efficiency in management of water draining and overflowing in specific areas, and 4) reinforcing dikes and following the King’s initiatives. In the long term, several measures will be implemented, including the construction of flood ways or water diverting channels, and preventive dikes for key economic areas, as well as land use planning.

2.2.1.4 Work Plan for Information Warehouse as well as Forecasting and Disaster Warning System

Work Plan for Information Warehouse as well as Forecasting and Disaster Warning System aiming at developing data system, creating hypothetical scenarios based on technical principles, setting up water management institutions, and increasing the efficiency in the warning system by 1) setting up the national water information center, 2) constructing hypothetical water scenarios, forecasting and disaster warning systems, 3) enhancing the national disaster warning system to be capable of monitoring and analyzing water situation in a timely manner by improving and increasing the number of water monitoring stations in major rivers, installing CCTVs at the water gates and pumping stations, upgrading satellite and remote sensing systems, and reorganizing and developing disaster warning systems.

2.2.1.5 Work Plan for Preparedness to Emergency Situation in Specific Areas

Work Plan for Preparedness to Emergency Situation in Specific Areas aiming to build capacity in prevention and mitigation of impacts from floods by developing the systems of flood prevention and mitigation in the important areas such as agriculture, industry, and dense community, creating the system for negotiating with the affected parties, constructing warehouses for tools, and assessing the impacts of private prevention systems.

2.2.1.6 Work Plan for Assigning Water Retention Areas and Recovery Measures

Work Plan for Assigning Water Retention Areas and Recovery Measures by assigning water retention areas in the upper and lower Chao Phraya River basins, developing the water retention areas to slow down water flow during flash floods, formulating a plan for diverting water into water retention areas whilst creating measures for special compensation to those areas assigned to be water retention areas.

2.2.1.7 Work Plan for Improving Water Management Institutions

Work Plan for Improving Water Management Institutions aiming at setting up integrated water management organizations, as a single command authority that can make prompt decisions during the crisis and is responsible for planning, monitoring and evaluation, revising rules and regulations. For the urgency period, this single command authority is the Ad Hoc Committee chaired by the Prime Minister or the assigned Deputy Prime Minister and comprises ministers and permanent secretaries of related ministries as members. In the long term, the national integrated water management agency should be set up permanently.

2.2.1.8 Work Plan for Creating Understanding, Acceptance, and Participation in Large Scale Flood Management

Work Plan for Creating Understanding, Acceptance, and Participation in Large Scale Flood Management from all Stakeholders. Government and development partners would call for collaboration with community and people in managing impacts from floods and other major disasters.

According to the water management master plan implemented by Thai government, those plans are the combination between hard measures and soft measures with the mainly aim to reduce, prevent and minimize losses and damages from flooding. However, from such plan, it will intentionally manipulate the two differential areas, which are beneficiaries' area where it will be well protected by such project especially the economic area such as Bangkok and non-beneficiaries areas where it suffers from flooding because of such project by assigning water retention areas to slow down water flow during flash floods and floodway areas as the shortcut way to drain water directly to the canal or the sea.

Table 2.3 Action Plan of Water Management for the Urgent Period

Work plan	**Fiscal year 2012 (mB)**	**Fiscal year 2013 (mB)**	**Time frame**
1. Work Plan for Management of Major Water Reservoirs and Formulation of Water Management	-	-	Report progress to SCWRM by Jan. 2012
2. Work Plan for Restoration and Efficiency Improvement of Current and Planned Physical Structure	12,610.34	4,515.70	Projects finalized by Jan. 2012

Table 2.3 (Continued)

Work plan	Fiscal year 2012 (mB)	Fiscal year 2013 (mB)	Time frame
1) Renovation of dikes, dams, check dams and water drainage system for capacity increasing	7,062.82		
2) Renovation of water drainage channel, digging canals, clearing canals and water drainage channels	1,695.27		
3) Increasing capacity in water drainage and water run-off management	2,984.05		
4) Strengthening dikes and carrying tasks recommended by King'sinitiative	868.20		
3. Work Plan for Information Warehouse, Forecasting and Disaster Warning System	4,500		Mar. 2012
1) Formulate Data Bank Plan/ Setup National Data Centre			
2) Formulate Forecasting System Upgrading Plan			
3) Formulate Warning System Development Plan including Setting up CCTV System			
4) Set up Water-Gate Remote Controlling System and Control Room			

Table 2.3 (Continued)

Work plan	Fiscal year 2012 (mB)	Fiscal year 2013 (mB)	Time frame
4. Work Plan for Response to Specific Area 1) Develop flood protection system in important areas 2) Set up tool storing system 3) Formulate evacuation plan in case of flooding 4) Formulate plan for tackling polluted water from flood 5) Formulate plan for rehabilitation effected people 6) etc.	1,000		Mar. 2012
5. Work Plan for Assigning Water Retention Areas and Recovery Measures 1) Identify monkey cheek reservoirs in upper and lower Chao Phraya Water Basin 2) Formulate plan for channeling water to monkey cheek reservoirs 3) Identify measures of compensation to effected people			Mar. 2012
6. Work Plan for Improving Water Management Institutions 1) Arrange meeting between SCWRM and SCRFD to propose			Jan. 2012

Table 2.3 (Continued)

Work plan	Fiscal year 2012 (mB)	Fiscal year 2013 (mB)	Time frame
work plan for revising organization for water management 2) Set up ask force committee to monitor operation according to Action Plan of Water Management for the Urgency Period			
Total	18,110.34	4,515.70	

Source: Office of the National Economic and Social Development Board, 2014.

Table 2.4 Action Plan of Integrated and Sustainable Flood Mitigation in Chao Phraya River Basin

Work plan	Budget (m ฿)	Time frame
1. Work Plan for Restoration and Conservation of Forest and Ecosystem Sample projects; 1) Soil improvement and conservation in the upper river basin by reforestation and rehabilitation of forest areas in the river basin in Ping, Wang, Yom, Nan, Sakae Krung, Tha-Chin and Pa Sak 2) Reservoir construction in Yom, Sakae Krung, Nan, and Pa Sak water basin	60,000	2012 onwards
2. Work Plan for Management of Major Water Reservoirs and Formulation of Water Management 1) Formulation of water management plan in major	-	2012 onwards

Table 2.4 (Continued)

Work plan	**Budget (m ฿)**	**Time frame**
dams and water management in various scenarios, as well as dissemination related information to the public		
3. Work Plan for Restoration and Efficiency Improvement of Current and Planned Physical Structures Sample projects; 1) Construction of flood ways or water channels roads, and dams and improvement of water dike, reservoir, water drainage and water gateway in order to deviate waters from Pa Sak and Chao- Praya rivers to the East or East and West efficiently. 2) Land use zoning and land utilization including setting up area protection system. 3) Improvement of quality of water in the main water channels and the remaining dikes	177,000	2012 onwards
4. Work Plan for Information Warehouse and Forecasting and Disaster Warning System Sample project; Establishment of the database system, forecasting system, and warning system as well as setting up the institution, rules and regulations and enhancing the public participation.	3,000	2012 onwards
5. Work Plan for Response to Specific Area 1) develop the system of flood prevention and mitigation in the important areas 2) set up the system of instrument and tool warehouse 3) negotiation with flood affected communities 4) treatment of polluted water due to flooding	-	2012 onwards

Table 2.4 (Continued)

Work plan	**Budget (m ฿)**	**Time frame**
6. Work Plan for Selecting Water Retention Areas and Recovery Measures Project example 1) Improving/adapting irrigated agricultural areas into retention areas (Monkey cheek reservoirs) of around 2 million rai to be able to grow second rice crop comprising of irrigated agricultural areas in Phitsanulok, Ramsar Site and Greater Chao-Praya Project.	60,000	2012 onwards
7. Work Plan for Improving Water Management Institutions 1) setting up the Task Force Committee for action plan management during urgency period. 2) setting up permanent integrated water management organizations.	-	2012 onwards
8. Work Plan for Creating Understanding, Acceptance, and Participation in Large Scale Flood Management from all Stakeholders. 3) Increasing public awareness of the progress in water management carried out by the public sector as well as encouraging people participation on water management.	-	2012 onwards
Total	300,000	

Source: Office of the National Economic and Social Development Board, 2014.

2.3 Sources of Revenue for Flood Management by Government

According to flood disaster occurring in 2011, it was evidently reflected that Thailand has not had the effective fiscal mechanisms to support future flood prevention investment including to especially compensating money to flood victim in term of complex procedure, efficiency and equity manner for solidarity propose. In addition, after flood disaster in 2011, land prices has not yet taken into account the flooding attribute such that, the evaluated prices of the areas where is often flooded especially flooding event in 2011 should be lower than the prices of the areas that were hardly flooded, it is because very low perceived probability of flood occurrence. From the reason mentioned above, the market mechanism in this sector unfortunately is not perfectly run in such a way that those people who need protection from flood have to purchase higher land price taken into account flooding attribute where is considered as flood resistant area for their safety. Therefore, government should initiate effective mechanism to deal with flood prevention. Theoretically, source of revenue for flood prevention and compensation can be coming from three sources which are;

2.3.1 Command and Control Mechanism: Government Budget for Traditional Flood Prevention Investment and Flood Compensation

From flood disaster in 2011, apart from water management scheme in which government has to undertake for flood prevention in the future, government compensation for disaster losses causing by flood damages in Thailand is also arranged so that the cabinet has agreed to pay 5,000 baht compensation to each flood-victim's family. Thailand's flood victims will only get compensation in cases where homes have been inundated for more than a week or where flash floods have damaged properties. Additionally financial aids will be provided to the flood-hit households as follows: a maximum of 30,000 baht payout for homes that have been completely damaged by the floods and 20,000 baht will be paid out for homes that suffered partial damages. Meanwhile, 25,000 baht compensation will be paid out to victims who died in the floods. The deceased is the breadwinner of the family; the family will be eligible for additional 25,000 baht compensation.

Traditional responses to flooding problems (flood prevention program, disaster relief, reconstruction including a hugh amount of compensation) have been constrained by the governments' generally weak fiscal position. Consequently, the potential economic losses and government spending for flood management and compensation increases. A rational behind flood management and compensation by the government instead of private insurance companies might be that the government is regarded as liable for flood damage. Furthermore; feeling of solidarity can be a reason to provide damage compensation.

For flood compensation, a disadvantage of the current system is that it is not clear in which cases flood damage will be compensated. The decision whether compensation is provided, as well as the determination of the extent of the compensation provided including the complex procedure mechanism to receive flood compensation lies with the government that is in office when the disaster takes place. Therefore, these decisions are influenced by political will and public pressure, which can be regarded as arbitrary and subjective. Decisions concerning compensation are likely to be driven by equity and political motives rather than by rational economic grounds, as research about flood damage compensation by the U.S. federal government indicates (Downton and Pilke, 2001). Uncertainty for individuals concerning the compensation of damage is less in case private insurances are available, since insurances provide a contractual right for compensation.

A major drawback of a public flood control project including compensation scheme invested by government is that incentives to limit or reduce losses for individuals are sub-optimal. These loss-reducing incentives are minimal when individuals expect that the government will provide flood prevention including compensation regardless of individual characteristics or prevention measures undertaken. In this way, government flood prevention and compensation schemes result in a governmentally subsidized incentive to take on risk. Another disadvantage of the current government flood prevention and compensation scheme is that flood control project including disaster compensation invested by the government may hamper economic development broadly if such project is financed through traditional taxes or reduced public investment in other areas. Then the government has become increasingly reluctant to provide this old traditional flood project and instead stimulates the development of new fiscal flood prevention arrangement to alleviate budget constraint. Moreover, most financial compensation mostly comes from general tax revenue paid by all Thai people. In accordance with water management plans initiated by government, these plans artificially manipulate both beneficiary and non-beneficiary areas. Therefore, using general tax revenue to compensate flood victims is considered as “unfair” manner.

2.3.2 Flood Insurance

Flood Insurance is a system of protection against loss from flooding, a person pays money every month (premiums) for a guarantee that the company will pay them money if they or their property is damaged or lost. The advantages of flood insurance can be useful in efficiently spreading of risks, enhance household’s financial security, and provide incentives to policyholders to limit flood damage. It is a risk- sharing due to the ability of insurance to spread the risk on a wide enough population to absorb the potential catastrophic nature of the hazard. Flood insurance can also provide incentives for individuals to limit losses by, for example, excluding coverage for damage from carpet or wooden floors, which stimulate the use of tile floors or water resistant timber floors. Another strategy to reduce flood losses and claims for insurance companies is to inform policy holders about flood-adapted building use and materials, as well as damage reducing measures that individuals can undertake once a flood occurs (Thieken et al., 2006). With the use of deductibles policyholders are motivated to be creative in limiting potential losses ex-ante, ex-post as well as during floods. For example, survey analysis indicates that insured individuals have spent more time on flood mitigation measures than uninsured individuals (Thieken et al., 2006). Another valuable characteristic of insurance is that insurance companies generally monitor activities of their policyholders. This monitoring is performed to determine whether policyholders operate in a manner consistent with underwriting standards. For example, if insurance arrangements provide premium discounts when loss-reducing measures are undertaken then insurance companies will monitor policyholders to verify whether specified standards have been met. Therefore, monitoring insured parties ex-ante ensures that loss-reducing measures are actually implemented and adhered to. However, loss-reducing measures may result in the evidence of countervailing influence of two effects: lower price of insurance (positive effect) and reduced likelihood or magnitude of loss (negative effect), which suggest that, despite the incentive structure of the loss-reducing measures attempting to award lower insurance prices for mitigation activities that lower expected losses, mitigation may serve as a substitute for flood insurance.

Although it might be desirable to extend private insurance coverage to flooding, several problems exist that make it difficult to establish a pure private market. There are serious challenges i.e., supply, demand, and government and market factors for flood insurance to function well. On the supply side, insurers may find it hard to design insurance products because of the difficulties in assessing flood risk and people's vulnerability, including estimating the potential damage of the flood. Also, high administrative costs in certain areas (especially rural areas), lack of access to reinsurance markets, and global climate change that causes extreme weather disturbances tend to adversely affect the commercial viability of these products. On the demand side, low demand for flood insurance, especially voluntary insurance, has been observed around the world. This is a result of a combination of lack of information, limited risk collective (the people who pool the risks), comprehensive government rescue or expectation of it, and low income. On the market and government side, relevant legislations and policies, as well as partnership schemes in flood management between the government and the private sector, have not yet to be established in most developing countries.

Table 2.5 Potential Challenges in Adopting Flood Insurance for Developing Countries

Supply side factors	1) Difficulty in assessing risk and vulnerability before disaster 2)Difficulty in estimating damage after the disaster 3) High administration costs 4) Limited access to reinsurance market 5) Global climate change

Table 2.5 (Continued)

Demand side factors	1) High premium due to limited risk collective 2) Limited awareness and information 3) Moral hazard problem (relying on government's disaster relief) 4) Low income
Market and government factors	1) Lack of relevant legislations and policies 2) Lack of clear partnership scheme between the government and the private sector

2.3.2.1 Supply Side Factors

Restriction to the supply of insurance can reduce total premiums volumes. Herweijer et al. (2009) and Mills (2005) highlight that, all else being equal, climate change could challenge the insurability of risk, reducing the availability of insurance, through increasing the technical uncertainty and volatility of risk, shortening the time between loss events and increasing correlation of losses. This could lead insurers to withdraw from certain regions lines of business or, if the changing risk environment is not properly anticipated, increased frequency of insolvency (CII, 2009). The parallel pressure of increasing concentrations of high-value insured assets in exposed regions could amplify the impact of climate change on insurability.

Assessing risk and vulnerability presents a big challenge for insurers. Demand for flood insurance is higher in areas that are repeatedly affected by floods and are clearly at risk. When insurers have difficulty assessing the risk of flood disaster for a particular area, it is only rational for them to assume high disaster risk and charge high premiums. High premiums, in return, dampen the demand for insurance from medium or low-risk groups for people. This results in a typical adverse selection or anti-selection problem.

Estimating flood damage can be difficult for insurers. Apart from the difficulty of assessing flood risk, damage assessment presents another challenge. Flood insurance contracts are usually designed in such a way that flood victims are paid out according to their losses, subject to a certain cap. If the losses are self-reported, there are incentives for the policyholders to provide insurers with wrong or misleading information regarding the damage, and expect transfers commensurate to their claims. Verifying damage could present huge informational constraints to the insurers.

Limited access to reinsurance market and global climate change tends to increase the cost of providing flood insurance. In developing countries formal weather-related insurance markets are generally weak. The limited access of insurance markets tends to increase the cost of providing flood insurance and leads governments to attempt to meet disaster costs through tax revenues or borrowing. At the same time, global climate change that induces flooding can also increase the insurance cost (DFID, 2004).

2.3.2.2 Demand Side Factors

Limited risk-sharing pool dampens demand for flood insurance. Insurers usually charge premiums that are commensurate with the flood risk and administrative costs, unless competition forces them to cross-subsidize flood insurance with other insurance products. There are two important consequences of offering flood insurance to a limited population on risk sharing pool. First, mutual insurance characteristics are lost. Insurance mechanism works better when potential risks are spread across a bigger population. This explains why existing flood insurance program tend to have national-level coverage. Second, if the loss burden is distributed over a small population, the premiums become considerably more expensive. Thus, limited risk collective results in each individual paying a high premium. Both consequences, in turn, dampen the demand for flood insurance.

Flood insurance will not improve economic efficiency, if people do not fully understand the risk involved in building or purchasing properties in flood-prone areas. Krutilla (1996) noted that a compulsory national flood insurance program could greatly improve the economic efficiency of floodplain occupancy. Therefore, in order to realize the efficiency gains, property owners must have sufficient information about flood risk and insurance premiums in order to make well-informed home purchase decisions.

Individuals at risk may not be prepared to pay premiums for flood insurance due to the moral hazard problem. People will have a higher tendency to stay in flood-prone areas when they know that they will be bailed out in case of a disaster. Thus, they have less incentive to purchase flood insurance for self-protection. If individuals at risk expect the state to compensate their loss through disaster relief, the moral hazard problem discourages them from exercising due caution and avoiding unnecessary risks. This is actually very common in many developing countries in which people build their dwellings in flood-prone areas and expect the government to provide flood protection and disaster relief.

The poor usually have a greater need for flood insurance, but cannot afford it without substantial government subsidy. The overall low income level presents a serious affordability constraint in promoting flood insurance. Paradoxically, within the floodplain, poorer households need flood insurance the most. Poor households are usually more vulnerable to floods than the rich. Poor households have insufficient resources to invest in flood-proofing measures for their houses and have a fewer choices in diversifying the risk. In addition, the poor generally have less access to saving and credit facilities needed to cope with difficulties in the aftermath of a disaster. The big challenge is how flood insurance can be designed in such a way that will make premiums affordable to poor households.

Role of disaster assistance, one of the arguments that had been advanced as to why individual do not adopt protective measures is that they assume liberal aid from the government will be forthcoming for those who suffer losses from a disaster.

Cancellation of policies, those who do purchase insurance are likely to cancel policies if they have not made a claim after a few years. It would not be surprising to learn that many of these individuals purchased a policy at the time that they took out a mortgage but failed to renew their policy the next year or several years later after not experiencing any flood losses.

2.3.2.3 Adverse Selection

The fear of problems relating to adverse selection is one of the main reasons why insurers resist government pressures to extend flood insurance coverage. Adverse selection occurs when high-risk individuals are more likely to demand insurance coverage than low-risk individuals. As a consequence, insurance companies will suffer losses when premiums are based on the average probability of a loss. Adverse selection is caused by information asymmetries between insurance companies and policy holders. This problem can arise when individuals are able to determine their individual risk characteristics and insurance companies have difficulties to distinguish good from bad risk individuals. In case information asymmetries would not exist, insurance companies could simply charge higher premiums to high-risk individuals. Adverse selection can result in very high premiums in case insurers are risk averse, which can explain a missing market. Adverse selection may arise when flood insurance is available, because individuals living in flood prone areas are more likely to demand insurance coverage against flooding.

2.3.2.4 Moral Hazard

Information asymmetries between insurance companies and policyholders can also result in moral hazard. Insured individuals may behave less carefully when they have insurance coverage, while this is unobservable by the insurer. This information asymmetry results in an inefficient level of risk prevention (Gollier, 2005). For example, persons with vehicle insurance are likely to drive less carefully, than persons without insurance, ceteris paribus. The probability of losses increases after the individual has bought insurance coverage due to the behavior of the policyholder, which is defined as moral hazard (Freeman and Kunreuther, 2003). Moral hazard can arise when individuals are covered for flooding. However, problems with moral hazard can be minor in practice, due to adequate design of insurance contracts (Thicken et al., 2006). In addition, the moral hazard of insured to be minor problem for flood insurances because insured agents do not have control over the catastrophe event, i.e. the probability that damage occurs, although insured have control over the extent of damage during and after the flood (Jaffee and Russel, 1997).

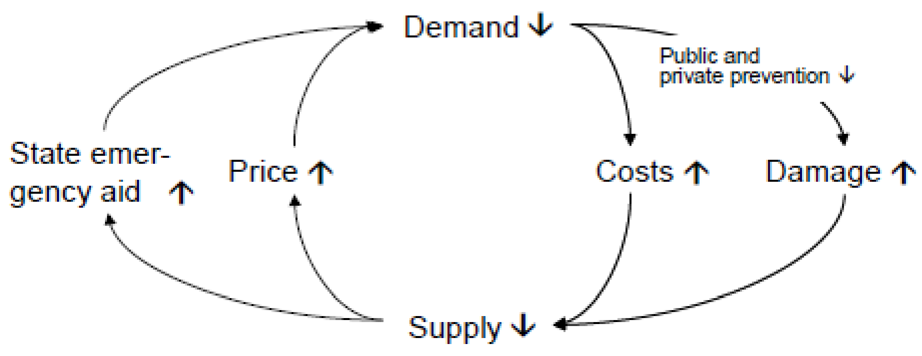

Figure 2.2 The Disaster Syndrome and Insurance

2.3.2.5 Economic Analysis of Flood Insurance

For equity manner, flood insurance should be considered as a fair distribution of income such that anyone who applies flood insurance has to pay standardized premium regardless of income level. Therefore, the poor who have lived in flood prone area are less likely to apply flood insurance because of high premium charged unless the government gives the relevant assistances.

For efficiency manner, flood insurance can be designed as efficiency as to stimulate loss-reducing incentive such that policyholders operate in a manner consistent with underwriting standards in exchange for premium discount to anyone who apply flood mitigation measures such as excluding coverage for damage, for example, carpet or wooden floors, the use of tile floors or water resistant timber floors etc. Moreover, differentiated premiums in which higher premium will be charged to the flood prone areas, may stimulate the movement of living place to the safer areas in order to prevent flooding. For example, those who have lived in flood prone areas have an incentive to tradeoff between moving to the safe place (paying low premium) and staying to the flood prone areas (paying high premium). If they have perceived the benefit of paying low premium, then they will move to the safe places, vice versa.

In term of flexibility, the insurance premium will be flexibly adjusted in accordance with the current situation such as inflation rate, flooding forecast in each particular year, for example, for the short period of time.

2.3.3 Revenue Obtained from Flood Tax

Flood tax is the system of protection against loss from flooding by collecting money in term of flood tax from the beneficial (those who are beneficial from hard measure projects to protect some particular areas) and paying back to further flood control project development or to the non-beneficial for compensation (those who suffer from flooding because of hard measure projects to protect some particular areas). The idea of the flood tax is based on flooding is the unexpected event and, at least for the short period of time, difficult for prevention. Moreover, the damage from flooding effect the number of people, therefore, the recovery from flooding should be joined together by those people who should be responsible for this risk as beneficiaries to the whole country. Moreover, from economic point of view, flood control management, implemented by Thai government as water management action plan should be considered as “positively public services” such that all people can join the direct or indirect benefits from those measures when the rainy season has come which is the main reason that most beneficiaries should be responsible to pay for flood tax in exchange from security from flooding for solidarity purpose.

The benefits of flood tax over the flood investment and compensation by government, and flood insurance is that it can reduce budget deficit of government by taking the moneys from the beneficiaries who can benefit from flood control project and paying them to the non-beneficiaries and for further flood control project development. Flood tax can also stimulate the incentive to loss-reducing behavior like flood insurance by using differentiate flood tax rate scheme according to geographic characteristic of each particular area in such a way that, the areas situated in the flood prone areas such as near the liver or in the low elevated area are more likely to pay the higher tax rate than the areas that are situated very far away from river or in the high elevated area. From the economic point of view, if those people benefit of such flood tax must exceed the cost, they will pay the flood tax in exchange for security from flooding; otherwise they would not be undertaken, by having an incentive to move their house to the flood resistant area in order to pay the lower tax rate. Therefore, from the flood tax principle, it encourages some people to greater rebuild their home in environmentally flood resistant areas, thereby finally reducing the magnitude of the resulting losses from flooding.

Moreover, according to the water management master plan implemented by Thai government, those plans are the combination between hard measures and soft measures with the mainly aim to reduce, prevent and minimize losses and damages from flooding. However, from such plan, it will intentionally manipulate the two differential areas, which are beneficiaries' area where it will be well protected by such project especially the economic area such as Bangkok and non-beneficiaries areas where it suffers from flooding because of such project by assigning water retention areas to slow down water flow during flash floods and floodway areas as the shortcut way to drain water directly to the canal or the sea. From that reason, flood insurance may not be fully and equally developed in some particular areas especially the assigned water retention areas and floodways areas, because those areas are surly flooded. Therefore, the insurers may not be willing to insure those areas from flood events. In this way, if the insurers provided the flood insurance in those areas, the potential catastrophic consequences for individual households and businesses are shifted to insurance companies leading to insolvency situation. Insurers limit their risk by restricting payouts through upper and lower limits (deductibles) of liability or by imposing restrictions and exceptions in insurance contracts. These measures transfer risks to businesses and households and increase pressure on governments to invest in flood prevention, and provide compensation if necessary (Botzen and van den Berge 2008). Excluding or limiting coverage may be regarded as undesirable since it decreases financial security of households, which lowers welfare of risk averse individuals. Increasing premiums is another strategy to deal with increased risks, which is commonly used after a major catastrophe event (Kunreuther et al., 2008). A problem with raising premiums is that this often result in public and regulatory resistance and may result in decreased market share if competition is fierce. That is the reason why the flood insurance is not applicable in this situation. Moreover, as supported by the study of Orapan, Hermi and Aini (2014) done in Thailand about the demand of flood insurance in households sector by interviewing the middle and poor households from three areas in Thailand where they faced severe flood in 2011 : Nonthaburi, Bangkok, and Pathum Thani. It was found that despite the bad experience from Bangkok flooding will reoccur in the next five years, only 22% of low income households and 37% of middle income households would be willing to purchase disaster insurance. The main reason of respondents for not buying the flood insurance obtained from questionnaire is that there is very little chance of flood reoccurring. Therefore, from the reasons mentioned above, flood tax should be more appropriate in such a way that it will overcome the problem of both flood compensation by government and flood insurance in term of reducing government financial burden and stimulating loss-reducing behavior incentive.

2.4 The Public Demand for Flood Control Project at Country Level

Until now, there have been not many papers written estimating the willingness to pay for flood control project especially relevant studies done in Thailand. These studies have been conducted in Virginia, United states of America (Thunberg and Sahbman, 1991), Wisconsin, United states of America (Duan and Clark, 2000), Bangladesh (Brouwer et al., 2003), Wisconsin, United states of America (Clark, Griffin and Novoty, 2005), Thailand (Nida Puttipiriya, 2009), and Thailand (Pantiwa, 2010).

However, none of the studies done in Thailand has examined the willingness to pay from the national master plan on water resource management with the aim to protect economic area such as Bangkok considered as beneficiary from flooding in exchange for paying the flood tax to support flood control project designed by water management plan by government at national level. Therefore, many key factors influencing the willingness to pay for flood control project including calculation of willingness to pay for national flood tax by using other techniques other than Contingent valuation method, with the aim of formulating efficiency flood tax scheme, remain unexamined.

There are a number of ways to estimate a value of the maintenance of the current flood risk levels in exchange for supporting flood control project in such a way that this flood tax can be used in many aspects such as paying a flood tax to compensate the people who suffer from flooding because of flood prevention project initiated by the government or it can be used for initial flood control project development or further dam maintenance after year of flooding, for example. This includes analysis of the relationship between private market goods and non-marketed, public goods, analysis of individual's preference as they revealed through the flooding preventive expenditure such as purchasing the sandbags and any material to prevent their properties from flooding, and the utilization of a survey or interview process that asks individuals to reveal directly their willingness to pay (WTP) for a stated level of public good. Methods of the evaluation of the benefits resulting from an improvement of flood control in exchange of paying flood tax can be divided into two categories: continent valuation, based on responses to hypothetical situations posed to individuals, and revealed preferences, based on observed choices and expenditures on avoidance behavior. This study uses both CVM survey and preventive expenditure approach, sampling of two types of district situated in Bangkok where one is affected by flood disaster in 2011 and another is not affected by flood disaster in 2011, in order to estimate the population's mean aggregate WTP for flood tax in exchange for maintenance of status quo flooding risk by flood prevention project implemented by government.

According to the economic models of an individual choice, we can interpret a household's observed tradeoff between income and flood risk as a measure of people's willingness to pay (WTP) for improvements in flood prevention. Catastrophic risk can reduce people's well-being through some extra expenditure preventive (mitigating, or defensive) expenditures associated with attempts to prevent flood risk; lost wage because of temporally unemployment in case of flooding, medical expenses associated with treating illness and diseases because of flood, including the opportunity cost of time spent in obtaining treatment.

2.4.1 The Study of Valuation Methods and Comparison

Evaluation of the flood tax in exchange for flood security was implemented by means of the analysis of a household's willingness to pay and actual expenditure on the market, related to flood prevention. Such a type of the economic valuation is called non-market valuation. It is commonly used in the case when a market price of some public good (such as flood control services) does not represent the actual cost of the good. Basic elements of the non-market valuation is the willingness to pay (WTP) of some economic agents for some change in the level of provision of a public good.

Willingness to pay for being obtain this change of a public good reflects the individual's preferences, so, it can be interpreted as a monetary measure of this public good or service. Non-market valuation consists of two different instruments: contingent valuation (CV) and avoidance expenditure (AE). Both are based on sociological surveys.

The preventive expenditures approach is based on the analysis of the actual household's expenditures, related to the reducing and mitigating flood risks from catastrophic event, and it is called an indirect valuation. In AE model household's avoidance measures (for example, purchase of sand bags) are taken as a basis for the estimation demand for the flood control project. If the flood risk increases, the households must increase their expenses to maintain constant status quo circumstance. Avoidance measures (such as purchase of sand bags) can be used to evaluate an individual's WTP to reduce the flood risk. When an individual can purchase a reduction in flood risk due to catastrophic event, the price of reducing that risk can be taken as a close approximation of the individual's WTP for flood tax in exchange for flood risk reduction. Given the date for each person on the cost of preventive measures he or she undertakes which is likely to vary among individuals and on the effect of preventive behavior on the flood risk reduction, one can estimate WTP.

In contingent valuation approach people are directly asked to estimate their willingness to pay for water control improvement in exchange for paying flood tax by using structured questionnaires. This approach is called a direct valuation. The main difference from the AE approach is the absence of actual purchase of the good, but households' estimation of the hypothetical procedure. The questionnaire describes some hypothetical change in flood control and prevention, for example and the respondent is asked directly for his/her potential WTP for this change. It is usually supplemented by attitude and demographic questions. The critics of contingent valuation method are primarily critical of the reliability and validity of answers to hypothetical WTP questions. The method seems to be quite vulnerable to biases. A great deal of research has been done to define such biases and explain how to avoid them which has resulted in setting up the guidelines for conducting proper CV research (Arrow et al, 1993). One of the ways to overcome strategic bias (i.e. premeditate bias of the WTP) and information bias (i.e. arising from incompleteness of available information) may be by carefully designing the structure of the research. In particular, special attention should be paid to the questionnaire, to the selection of the sample and to the offered payment (i.e. payments in the form of taxes, monthly tariffs, etc.) So called systematic biases (i.e. inherent to the CV method) can be smoothed over by the preliminary surveys in small groups.

The important question that we consider in the empirical part is the difference between contingent valuation and the preventive expenditures estimates of the willingness to pay for flood control. According to Dickie et al (1986), the preventive expenditure estimate of WTP was regarded as an upper bound because the full cost of avoidance activities that produce joint products were attributed to reducing flood exposure. It suggests that household's preventive expenditures on average should be higher than its willingness to pay for flood control project. However, in contrary, as shown by Harrington and Portney (1987), The WTP for flood risk improvement can be written more explicitly as a combination of two terms: the dollar value of the utility improvement due to decrease of flood risk exposure; plus the reduction in preventive expenditures associated with an improvement in flood control project. Therefore, the household's preventive expenditures on average should be lower than its willingness to pay. The same theoretical result has been obtained in Larson (1999).

2.4.2 The Study of Willingness to Pay for Flood Control Project

On the whole the study of demand for flood control project was mostly related to the willingness to pay (WTP) as the part of CVM, no other valuation methods have been used in this study area anymore. The application of CV studies in the domain of flood exposure and flood control, where people are asked to trade-off money income in term of willingness to pay (WTP), in exchange for the risk of flooding and corresponding impacts on their life and livelihood.

Table 2.6 The Studies of Willingness to Pay for Flood Control Project

Study	The country case study	Target population	Size
Thunberg, Eric and Sahbman. Leonard (1991)	Virginia, USA	owners of flood prone parcels within the city of Roanoke, Virginia	134
Duan, Margaret C. and Clark, David (2000)	Wisconsin, USA	households in the Menomonee River and Oak Creek watersheds	999
Brouwer, Roy; Akter, Sonia ; Brander, Luke and Haque, Enamul (2003)	Bangladesh	floodplain residents currently living without any flood protection along the river	700
Clark, David E.; Griffin, Robert; and Novoty, Vladimir (2005)	Wisconsin, USA	residents of two impacted watersheds in the Milwaukee area Wisconsin	570
Zhai, Guofang (2006)	Japan	residents in Shonai-Toki river basin in central Japan	1,000
Nida Puttipiriya (2009)	Thailand	samples in Chiang Mai province	352
Pantiwa. S (2010)	Thailand	Household and entrepreneurs living nearby the liver in Bangkok	643

Up until now, there have been not many studies dealing with flood risk and watershed management using the application of CVM for flood control project conducted in various countries, target population and sample sizes with the aim to estimate the willingness to pay for flood control project. The all study in Virginia, Wisconsin (both in united states of America), Bangladesh, Japan and Thailand surveyed mainly samples of the resident in the flooding areas where it will directly benefit from flood control project with different sample sizes.

Table 2.7 The Outcomes of Willingness to Pay Amounts among Seven Different Studies

Study	The willingness to pay amounts on the flood control project
Thunberg, Eric and Sahbman. Leonard (1991)	56% people favored the tax increase to support the project but WTP in this study was not calculated
Duan, Margaret C. and Clark, David (2000)	WTP in this study was not calculated
Clark, David E.; Griffin, Robert; and Novoty, Vladimir (2005)	Mean WTP for the flood protection scheme is 3.23 (US$/household/year) for logistic probability model and 4.29 (US$/household/year) for turnbull model
David E. Clark, Robert griffin, and Vladimir Novoty (2005)	Average WTP is US$ 88.98 for flood control project (Lump sum)
Zhai, Guofang (2006)	The WTP level of different flood reduction measures range from ¥ 2,887 to 4,861 in term of mean and from ¥ 1,000 to 2,000 in term of median (Lump sum)
Nida Puttipiriya (2009)	Mean WTP for flood prevention is 410.54 BHT per household per month Median WTP for flood prevention is 347.96 BHT per household per month
Pantiwa. S (2010)	Mean WTP for improving the quality of Pasak Jolasid dam with the aim for flood prevention in household sector is BHT 489.69 per month and for business sector is BHT 1,628.76 per month Median WTP for improving the quality of Pasak Jolasid dam with the aim for flood prevention in household sector is BHT 246.88 per month and for business sector is BHT 697.01 per month

Regarding the willingness to pay for flood prevention among different population groups, the amounts of an individuals' willingness to pay for flood prevention had been diversely in line with the different flood prevention schemes in each study. It was also clear evidence that people with higher income had a statistically higher WTP for flood prevention measure than did low-income people Brouwer et al., 2003.

2.4.3 The Key Determinants on WTP Study

Among these studies as shown in table, at least five out of seven studies confirmed that significant determinants having a positive impact on willingness to pay at a given price were income, risk of flooding proxy by such as flood damage cost, experience of flood, and distance to the river and inundation level.

Table 2.8 Key Significant Determinant on Different WTP Studies on Willingness to Pay for Flood Prevention Measures

Study	income	Risk of flood
Thunberg, Eric and Sahbman. Leonard (1991)	(+)	(+)
Duan, Margaret C. and Clark, David (2000)	(+)	(+)
Brouwer, Roy; Akter, Sonia ; Brander, Luke and Haque, Enamul (2003)	(+)	(+)
Clark, David E.; Griffin, Robert; and Novoty, Vladimir (2005)	N/A	(+)
Zhai, Guofang (2006)	(+)	(+)
Nida Puttipiriya (2009)	(+)	N/A
Pantiwa. S (2010)	Not significant	Not significant

Three articles dealing determinants on WTP for flood risk and watershed management using the application of CVM for flood control specifically as highlighted by Thunberg (1988), Shabman and Stephenson (1996), Swallow and Weaver (1999) recommend an importance explanatory variable necessary to effect the willingness to pay for flood control project. Overall, the various studies on flood risk, watershed management and general risk offer several important implications for this study. First, it is very important to create a believable hypothetical market for the public good that will be easy for the respondent to understand and value. In addition, behavioral and attitudinal factors and not just demographic and income data are important to control for when valuing any public good using WTP. This would include both political leanings and alternative risk aversion measures of respondent. Finally, strategic behavior and protest bids can have a significant impact on the final WTP equation and should be controlled for in the regression analysis.

2.4.3.1 Attitude, Experience with and Subjective Assessment about the Risk

Affective feelings are important in individual risk judgments according to Slovic et al. (2001). Individuals may have a higher risk perception if flood risk is associated with negative feeling, which may have been caused or reinforced by experiences with flooding or evacuation in response to flood threat (Finucane et al., 2000; Keller et al., 2006). This is related to the relevance of the “availability heuristic” in risk perception discussed by Tversky and Kahneman (1973; 1974). Heuristics are simple rules that individuals may use in risk judgments. Individuals who use the availability heuristic in forming perceptions judge an event as risky if it is easy to imagine and recall. For example, individual who experienced a flood may find it easier to imagine a flood happens again in the future and therefore, indicate a higher perceived risk than individuals without flood experience. Research has shown that more intense personal experiences, such as suffering damage, results in elevated perception of risk (Windham et al., 1977; Perry and Lindell, 1990; Norris et al., 1999, Raid et al., 1999). In addition to experience with a hazard, knowledge of individuals about risk can affect its perceived riskiness. It may be expected that individuals who know very little about natural hazards do not worry much about the risk they pose. In term of WTP for a risk reduction, the relevant measurement of risk is people’s subjective assessment of risk, rather than a scientifically observed measure. As Smith (1992) point out, the use of subjective rather than objective risk assessment is more correct if one assumes that the general model of decision-making under uncertainty is prospective reference theory as an extension of standard expected utility.

Thunberg (1988) surveys a residential neighborhood in Southeast Roanoke, Virginia comprised of 142 properties, located within the floodplain of the Roanoke River during a two week period in 1987. Thunberg estimates WTP using log-log, linear-log and purely liner functional forms. As all of Thunberg's specified models are linear in their parameters, ordinary least squares is used as the estimation method. In his models Thunberg includes the following explanatory variables: a flood zone indexed variable based upon frequency of flood occurrence for a particular parcel, an expected structure plus contents value benefits, the structure plus contents value of home, an expected anxiety relief benefit variable, a tenancy status dummy variable, a community effects variable defined as the individual's subjective assessment of the potential benefits for the community at large, an expectation of property value changes, a dummy variable controlling for landowners that have immediate plans to sell their property, a flood insurance premium, and an income variable.

Thunberg (1988) states that the hypothesis that WTP is positively related to flood zone is consistent with an expected future flow of protection services definition of flood control benefits. However, Thunberg empirically rejects this hypothesis. Thunberg indicates that these finding are largely due to empirical issues and model specification problems and argues that the theoretically positive relationship between WTP and the reduction of flood risk is not questioned by his findings. Thunberg's results have one critical implication for this study. It is critically important to assess the explanatory power of attitudinal/behavioral variables. Including such variables may allow for the identification of respondents believe about safety form flooding by their property location and for the assessment of a respondents relative feelings of frustration, victimization, and trust or mistrust of government.

Thunberg and Shabman (1996) survey the 134 owners of flood prone parcels within the city of Roanoke, Virginia. Thunberg and Shabman estimate WTP using log-log liner functional forms. As all of Thunberg's specified models are linear in their parameters, ordinary least squares is used as the estimation method. In their models Thunberg includes the following explanatory variables: individual's expectation of a change in property damages with the project, individual's expectation of a change in land value with the project, individual's expectation of a reduction in anxiety with the project defined as a disordered psychic or behavioral state resulting from a feeling of apprehension or fear over the prospect of flooding and self-doubt about the capacity to cope with flood threat, individual's expectation of a reduction in social; and economic community disruption, individual owns flood insurance dummy variable, income and time horizon o the individual.

Thunberg (1988) states that estimated benefits of flood control projects are typically not only limited to avoided property damages but also the possibility that there are benefits from reduced psychological stress among flood plain occupants and benefits to the community has long been recognized. They found that non property consideration did help explain their willingness to pay for flood control. Of particular importance was the respondents' concern for disruption of the community caused by possible flooding such that the adverse effect of recurring flood events on the social and economic fabric of a community is often cited by supporters of flood hazard reduction projects.

In addition Clark, Griffin, and Novoty (2005) assessed the determinants of willingness to pay for urban flood control. In this study, 1,000 residents of the Menomonee water shed in Mulwaukee were interviewed in a two-wave panel survey in year of 2000 and 2001 to determine their willingness to pay for a referendum which would prevent flood risk from worsening. The interviews queried respondents about their attitudes concerning flooding risk, political relief, information seeking behavior, and other psychological factors unique to respondent. A willingness to pay function was estimated using Tobit analysis. One would expect that the willingness to pay (WTP) to prevent the worsening of flood risk. Economists and regional scientists have evaluated the role played by traditional demographic factors. However, attitudinal factors measuring community norms, political philosophy, and other psychological factors that may be unique to the individual have not received the same level of scrutiny. Preliminary finding indicated that all three categories of factors influence willingness to pay, with psychological factors and flood risk factors having a relatively strong impact on willingness to pay.

Knowledge about risk perceptions of natural hazards may provide important information about individual decisions to take self-protection measures; and public support for governments' risk reduction policies. Household risk judgments can also support the legitimacy of, and compliance with, land-use planning and other risk reduction policies that are undertaken by governments (Peacock et al., 2005). Political support by individuals for risk reducing investment is stronger if risk to be reduced is perceived as great by citizens (Viscusi and Hamiltons, 1999). Detailed information about risk perceptions may further improve communication about risk reduction policies to the public. Most risk perception research has focused on explaining risk perception by prior experience, knowledge, and socioeconomic as well as demographic characteristics (Sjoberg, 2000). Brilly and Polic (2005) observed that flood risk awareness is higher in a flood-prone area in Slovenia than in areas where flooding is less common. According to Siegrist and Gutscher (2006), Swiss household' perceptions of flood hazards were related to the riskiness of a location based on flood risk map.

2.4.3.2 Geographical Characteristics

Three variables reflect objective indicators of the flood risk faced by the respondent based on geographic characteristics normally used in many studies. These geographical variables indicate the difference between the elevation area of the respondent, the distance of the house to a main river and whether the respondent lives in an area that is not protected by dikes. The explanatory variable capturing the relative elevation of a location can be used as an indicator of potential flood damage. The lower the location of the area, the higher is the potential water level during a flood.

Most risk perception research has focused on risk perception by prior experience, knowledge, and socio-economic as well as demographic characteristics. Peacoke et al. (2005) find that perception of hurricane risks are positively related to living in the area with high potential wind speeds. Brilly and Polic (2005) observe that flood risk awareness is higher in a flood-prone area in Slovenia than some areas where flooding is less common. Perceptions of flood hazards of Swiss households were related to riskiness of a location based on flood risk maps by Siegrist and Gutscher (2006). It can be observed a significant and positive relation between risk perception and expert assessment of risk.

2.4.3.3 Socio-economic and Demographic Characteristics

Several studies indicate that perception of risk vary between different groups of people (Leiter, 2008; Hakes and Viscusi, 2004). For this reason it is relevant to examine how perceptions of flood risk are influenced by socio-economic characteristics of the individual. Gender is often found to be an important determinant of risk perceptions (Gustafson, 1998). Women perceive risk differently than men and are often more likely to view disaster events and natural hazards as risky (Tuner et al., 1986; Fothergrill, 1996). Moreover, it is generally observed that individuals with a high income and education level have a lower perception of risk (Slovic, 1997, 2000). It is argued that it may be that societal groups that are more vulnerable, for example, poor individuals, females, or minorities, fear natural hazards risk more and report elevated perceptions because they may have less capacity to cope with the consequences of natural catastrophes. In contrary, it was also clear evidence that people with higher income had a statistically higher WTP for flood prevention measure than did low-income people (Brouwer et al., 2003).

Some studies indicate that age and household composition may also affect perception of hazard risk. A positive relation between age and risk perception has been found in some studies while a negative relation was assessed in other research (Peacock et al., 2005). In addition, the effect of the presence of children in the household on risk perceptions has been mixed, with some studies finding a positive significant effect (Tuner et al., 1986; Peery and Lindell, 1990) and other reporting no effect (Baker, 1991; Lindell and Prater, 2000).

2.5 Flood Tax

The idea of the flood tax based on flooding is the unexpected event and, at least for the short period of time, difficult for prevention. Moreover, the damage from flooding effect the number of people, therefore, the recovery from flooding should be joined together by those people to be responsible for this risk to be beneficial to the whole country which reflect in form of “flood tax”. Moreover, from economic point of view, flood control management, implemented by Thai government as water management action plan should be considered as “positively public services” such that all people can join the direct or indirect benefits from those measures when the rainy season has come which is the main reason that most beneficiaries should be responsible to pay for flood tax in exchange from security from flooding. It also emphasizes the importance of considering optimal resource allocation (efficiency) from a societal perspective in such a way that who are likely to be involved in financing for flood tax and distributional issues (equity) with respect to the affected stakeholders.

According to the water management master plan implemented by Thai government, those plans are the combination between hard measures and soft measures with the mainly aim to reduce, prevent and minimize losses and damages from flooding. However, from such plan, it will intentionally manipulate the two differential areas, which are beneficiaries’ area where it will be well protected by such project especially the economic area such as Bangkok and non-beneficiaries areas where it suffers from flooding because of such project by assigning water retention areas to slow down water flow during flash floods and floodway areas as the shortcut way to drain water directly to the canal or the sea. Therefore, those who will directly and indirectly benefit from such projects should be responsible to those who suffer from such project in term of compensation.

2.5.1 Efficiency

Efficient taxation requires that relatively high rates of taxation be levied on relatively inelastic goods. Therefore, investigating elasticity of flooding preventive expenditure or willingness to pay for flood tax in exchange for security from flooding is important factor for government in designing the efficiency flood tax regime. Moreover, efficient differentiated flood tax designation such that those who have lived in low-lying area should pay higher tax than those who have lived in high area which may stimulate the movement of living place in the more safe place where is the high area in exchange of paying the lower flood tax.

2.5.2 Equity

The design of a disaster management strategy needs to consider how losses after a disaster are allocated among victims after flood control project implementation (beneficiaries and non-beneficiaries). Careful consideration must be given to financial arrangements that allocates resources efficiently given equity considerations, and that is also politically realistic. According to tax equity which makes a fair distribution of income such that all those who benefit from flood control project have to pay flood tax. However, in order to help the poor, either progressive tax system under which an individual's average tax rate increases with income should be implemented or the flood tax for people considered as low income people should be waived. It should distribute burdens fairly across people with different abilities to pay. In particular, income should be taken first from the rich because the marginal utility lost is smaller than that of the poor. Therefore, those who have a higher income and live in a well-protected areas as a result of such water management action plan should pay more tax rate ,for the propose of fair distribution of income, in order to compensate the non-beneficiaries from such project.

2.5.3 Legal Issue

In term of economic perspective, flood tax is theoretically applicable, but in legal issue, it will be questionable that flood tax is legally applicable especially the problem of discrimination aspect. At the state level, especially, Bangkok law and regulation, it will have some legal interpretation and limitations such that whether or not , first, flood tax can be legally collected in accordance with Bangkok law and regulation, second, tax levied from residents in Bangkok areas may be not used or contributed to other areas despite of the fact the flood affected areas should be compensated by such tax because Bangkok area may get benefit in from of not getting serious flood because of water management plan aiming to protect economic zone by assigning other areas to be flood retention areas. At the national level, in accordance with constitution law interpretation, it will allow the government to legally collect the flood tax as long as it will not be treated as unfair discrimination. However, levying flood tax with differential rate based on income is not considered as unfair discrimination but just inequitable treated manner such that higher income people should pay a higher tax rate than the lower for the purpose of using money for the majority of community. When considering at this point, it can be seen that it can allow the government to collect flood tax without contradiction to the constitution law. In practical, designing law, either state or national level, to levy flood tax should be carefully done with transparency and accountability in order to reduce the social conflict.

2.5.4 Flexibility

Because flood tax designation is solely determined by government, therefore, the change of the flood tax policy in term of term and condition, rate of payment including cancellation etc. can flexibly be changed with the short period of time as required according to the government decision and economic situation. Therefore, because flood tax scheme considered as market-based mechanism can solve the government fiscal burden from command and control mechanism and fulfill the economic perspective in term of equity, efficiency and flexibility manner that is why we are interested in flood tax design in this study.

2.5.5 Flood Tax Bases

The more important issue is that what are the most appropriate tax bases undertaken for flood tax levy. In general, flood tax base design can be based on many tax bases according to the possibility and ease in implementation or consistency in principle or objectives for flood collection.

2.5.5.1 Asset Tax Base

Levying flood tax based on asset tax, such as land and property value can be in theoretically practical in term of solidarity and equity aspect. Natural hazards and subsequent public intervention such as floodplain designation will have an influence on the market value and location of property for example there would be movement of housing locations towards lower damage areas in flood prone areas. In essence, house values will fall in high risk areas so that it would seem reasonable to hypothesize that floods would have a negative effect on house value. The occurrence of a flood will cause damage to structure on floodplain, thus reducing utility of land, which will be manifested in lower property values. It is hypothesized that the more severe the flood experience, in term of greater depth, longer duration, the grater the decline in land value. The advantage of this tax base scheme is that it can clearly identify either what the beneficiaries' areas or the non-beneficiaries areas are. Moreover, the areas protected by flood control project will get benefit reflected in form of higher land value bought and sold in the market meaning that those who live in those areas will pay a higher flood tax rate for equity manner. However, Thailand currently lack the information about geographic value added to the land or asset in order to reflect flood risk for adjusting land value for the purpose of flood tax collection. Moreover, land prices are currently not taken into account the flooding attribute because of low probability of flood occurrence. The disadvantage of this scheme is that it is difficult to implement because of political resistant such that those who own the high value of asset normally are rich and political person that can influence the national political policy.

2.5.5.2 Environmental Tax Base

This tax is collected based on the level of environmental damage occurred in particular areas such as a level of gas emission for the industrial plant, etc. This tax revenue can also be used for recovery propose from catastrophe event such as flooding. However, the disadvantage of this tax base scheme is that it cannot identify beneficiary and non-beneficiary areas from flood control project.

2.5.5.3 Consumption Tax Base

The good example of consumption tax base is value added tax (VAT) by increasing the current tax rate. The advantage of this tax base scheme is that the revenue collected form this tax base is substantial so that making enough revenue to compensate to flood victims. Unfortunately, like environmental tax base, it cannot identify beneficiary and non-beneficiary areas from flood control project. In addition, collection of flood tax based on consumption tax especially VAT in some particular area for example Bangkok, can manipulate the incentive of people who are living in Bangkok to purchase goods and services in the neighboring areas in order for not paying higher VAT ,instead.

2.5.5.4 Income Tax Base

It is very easy and simple for implementation because Thailand already had the income base system implemented. Therefore, with better design flood tax system based on income tax such as collecting flood tax based on income for those who have lived in beneficiaries area, be in theoretically practical in term of solidarity and equity aspect. However, there is some limitation with income tax base in such a way that the numbers of Thai population who pay the income tax are limited, therefore the whole revenue collected form flood tax may be not enough to flood control project investment and compensate for flood victims without partly government subsidize.

Table 2.9 Types of Flood Tax Base Scheme

Types of Flood Tax Base	**Advantages/Disadvantages**
Asset Tax Base	Advantages : clearly identify beneficiary or non-beneficiary areas and practical in term of solidarity and equity aspect Disadvantages : difficult to implement because of political resistant especially rich people and land prices currently not taken into account the flooding attribute because of low probability of flood occurrence
Environment Tax Base	Advantages : can also be used for recovery propose from catastrophe event such as flooding Disadvantages : cannot identify beneficiary and non-beneficiary
Consumption Tax base	Advantages : revenue collected form this tax base is substantial Disadvantages : cannot identify beneficiary and non-beneficiary
Income Tax Base	Advantages : easy and simple for implementation because Thailand already had the income base system implemented and practical in term of solidarity and equity aspect Disadvantages : the numbers of Thai population who pay the income tax are limited

2.6 Countries implementing Flood Tax

2.6.1 Australia

As of January, 2011, Australia government launched the temporary law to collect so called as the flood tax in order to help the government from budget deficit which is more than 5,000 million dollar (AUS) and help fund the rebuilding of essential infrastructure damaged by natural disasters. The flood levy is designed to help affected communities recover from the recent natural disasters by providing additional funding to rebuild essential infrastructure. This includes roads, bridges, and schools. The flood levy will apply for the 2011-2012 income year and will be paid by most taxpayers. The principles of "flood tax" are such that; first, for those who are affected by flood officially declared by government as flood disaster areas and those who are considered as low income in the fiscal year are exempted from flood tax. Second, implement progressive taxing system illustrated in table 2.10

Table 2.10 Progressive Tax Implemented in Australia

Annual income	Extra tax per week	Extra tax per year
50,000	0.00	0
60,000	0.96	50
70,000	1.92	100
80,000	2.88	150
90,000	3.85	200
100,000	4.81	250
11,000	6.73	350
12,000	8.65	450
13,000	10.58	550
14,000	12.50	650
15,000	14.42	750
16,000	16.35	850

Third, any donation in case of flooding is not considered as flood tax. Lastly, flood tax should be initially collected in the fiscally subsequent year after the year of flooding occurs.

2.6.2 Pakistan

Floodwaters that have devastated parts of Pakistan for five weeks have headed to the Arabian Sea, leaving 1,707 people killed, 2,631 injured and over 15 million affected. Therefore, the Pakistani government has decided in principle to impose a 2 percent flood tax on all imports and a 5-10 percent flood surcharge on all incomes for undertaking reconstruction and rehabilitation projects after the country was hit by worst-ever floods over the past two months. These two measures were expected to generate up to 150 billion rupees (1.76 billion U.S. dollars), 50 billion rupees from flood tax on imports and 100 billion from flood surcharge on incomes, including salaries and profits, not only for individuals but also for association of persons, companies, business and traders. The proposed taxes would be imposed initially for the current year, but could be considered for continuation into the next financial year (2011-2012).

2.6.3 Germany

In the year of 2002, Germany faced the flood catastrophic event causing the damage up to 15 billion euro. At that time, Germany launched the fast tract law so called "Flutopfersolidarittsgesetz" or "Flood victim solidarity law" for the propose of reducing financial burden of government for flood recovery and compensation. The main objectives of this law are to postpone the reduction of personal income tax rate from the year of 2003 to be 2004. In addition, this tax allows the increase of corporate income tax rate from 25% to 26.5% in the year of 2003. From this law outcome, Germen government can raise the revenue more than 7 billion euro. That revenue can be used to compensate the flood victims and national infrastructure repair.

Table 2.11 Flood Tax Base Implemented in Countries

Country	**Tax base**
Australia	Progressive Income tax
Pakistan	Import and income tax
Germany	Personal and corporate income tax

CHAPTER 3

METHODOLOGY

3.1 Theoretical Concept

Our study used a survey interview technique to present a hypothetical CVM scenario and asked whether the working populations who have lived in Bangkok would be willing to financially support the flood control projects. We specifically surveyed the average flood prevention costs at the time of flood disaster in 2011 and their willingness to pay (WTP) for a support of flood control projects, targeting general working populations who have lived in Bangkok: both male and female workers over the age of 15, at a specified rate. In order to support government flood prevention projects, we asked individuals how much they were willing to make as a "yearly payment for flood prevention project" or, another word, their willingness-to-pay (WTP) as part of their yearly income taxes for this scheme.

Benefits from flood control can arise both directly and indirectly benefits to individuals and the community at large. The definition of "use value" was defined as a beneficiary whose values were revealed from market behavior such as flood prevention costs, while "non-use value" referred to values that were not revealed by market behaviors such as altruistic (sense of "doing the right thing" for the whole community). People as beneficiaries will fully or partly support this program because they will have benefits from such project. Direct benefits are those that accrue directly to a given individual or group, in contrast, indirect benefits are experienced by the entire community. Specifically, given the spatial nature of these benefits, some direct benefits can accrue to a subset of the population. These benefits may be private, for example, if a project reduces the probability of flooding, those residents living in the floodplain areas will be expected to experience less flooding then, the number of future flood victim is reduced and hence experience direct benefits and/or indirect benefits. Publicly provided goods (e.g., roads, public buildings, etc.) are also less likely to be damaged so that the community avoids future repair costs following flooding, fewer relief effort, etc. On the other hand, non-beneficiaries who never experience with flooding because they are situated in the flood resistant areas will possibly agree to subsidize this flood control project in some extent due to altruistic reasons. There are also indirect benefits to the wilder community emanating from flood control projects. Indirect benefits may be commercial (e.g., businesses avoiding passing on increased costs due to flooding to their consumer) or they may be altruistic (sense of "doing the right thing" for the whole community, valuing the environment, etc.). It referred to a case where one individual (non-beneficiaries) cared about the general level of well-being of others and did have preference regarding the composition of consumption bundles of others. That is, if altruism takes the paternalistic form, then the resulting non-beneficiaries values are applicable to the policy analysis. Also, when paternalistic altruism prevail, existence value plays a major role in determining whether benefits exceed costs because existence value is a person's willingness to pay for the preservation, protection, or enhancement of resources for which he or she has no plans for personal use. This role that altruism plays in generating existence value, and hence its influence on benefit cost analysis, depends on the motives for altruism.

3.1.1 Contingent Valuation Method

Economists have long understood the difficulty associated with the valuation of non-market goods and various techniques have been developed in an attempt to value goods that generates positive level of satisfaction to the consumer. Non-market goods may have both public good and private good attributes. Whereas consumers reveal their preferences for private goods by interacting with seller in the markets, such markets do not necessarily exist for public goods. This is due to market failure that results from non-identifiable individual property rights. That is, consumers cannot be excluded from enjoying the good once it is provided (i.e. the good is non-excludible), and the good is also non-rivalous in that one person's consumption does not inhibit another individual from also consuming the good.

The numerous techniques available for estimating WTP can be broadly divided into two categories: revealed preference and stated preference methods. The former, such as the travel cost and hedonic price methods, determine the demand for goods or services by examining the purchase of related good in the private market place, while the latter, such as the contingent valuation method and choice experiment techniques, measure demand by examining the individual's stated preference for goods and services relative to other goods and services. The CVM is a technique that allows the value of environmental goods and services to be estimated by asking people directly, usually by mean of a survey questionnaire, their willingness to pay (WTP) for a change in the availability of such environmental goods and services. The individual maximum WTP for an environmental change is assumed to be the value the individual attaches to such a change. The major advantage of this approach compared with the reveal preference methods is that the CVM can elicit both use and non-use values.

The good under consideration in this study is flood control project proposed on water management master plan initiated by government in exchange for paying flood tax. In addition, the resulting benefits are both direct and indirect. Specifically, given the spatial nature of these benefits, some direct benefits can accrue to a subset of the population. For example, if a project reduces the probability of flooding, those residents living in Bangkok area will be expected to experience less flooding and hence experience direct benefits. Publicly provided goods such as roads, public buildings, etc. are also less likely to be damaged. However, there are also indirect benefits to the wilder community emanating from flood control projects. Indirect benefits may be commercial (e.g., businesses avoiding passing on increased costs due to flooding to their consumers) or they may be altruistic (sense of "doing the right" for the whole community). Additionally, flood control projects have private good attributes as well as their obvious public good attributes. Households will experience differentiable and rivalrous benefits depending upon how the flood risk level specific to each household is affected by the abatement plan such that risk reductions are not equal in relative terms. Although, flood abatement plans have private as well as public good attributes, there is no immediately observable or readily accessible market for flood risk reduction, as there is for most private goods. As a consequence, households cannot directly reveal their demand for the privately accruing benefits of flood mitigation plans. Therefore, the CVM is one methodology that can be usefully applied in this study, which requires the valuation of non-market private and non-market public goods. The general measurement standard of the value of goods and services is defined as the willingness of users to pay for each increment of output from a plan. For flood control projects, benefits could logically be derived from both a consumer WTP to avoid damages to property and to avoid the social and psychological dislocation associated with flooding.

3.1.2 Theory of Contingent Valuation Method

Basic utility theory is used in this study to guild the development of a theoretical model to describe a household's willingness to pay for two separate good, market good and non-market good which is flood control project. It is assumed that an individual maximizes his or her utility subject to a budget constraint. In this study, the household's utility can be described by a vector of market goods, X, and a non-market good, Z. From Samuelson (1954), the value of non-marketed public good, which is not priced and can only be provided in a fixed amount, is given by the household's WTP for the non-market good. This will be shown to be related to the consumer surplus, or area under the consumers demand for the non-market good. The optimization problem is defined by equation (3.1.1).

$$Max\ U(X; Z) \text{ s.t. } P_i X_i < Y \qquad (3.1.1)$$

Where Y is income and P is a vector of prices for the marketed good in vector X. Solving this optimization problem generates a demand function for the market good, defined by equation (3.1.2).

$$X_i = X_i\ (P, Z, Y) \qquad (3.1.2)$$

From equation (3.1.2) it is seen that the level of a non-marketed good enters as an argument in the demand for a marketed good. However, because the non-marketed good is not priced it is not possible to similarly derive a demand function for the non-marketed good from the utility maximization system. However, the dual of the utility maximization problem is the expenditure minimization problem. Specifically, minimizing the expenditure function, conditional on a given level of utility, as shown by (3.1.3), can be used to derive the willingness to pay function.

$$Min\ P_i\ X_i = M \text{ s.t.: } U(X, Z) = U^* \qquad (3.1.3)$$

U* is a reference level of utility and M is the minimum money expenditure required to attain U. By solving (3.1.3), the household's expenditure function results:

$$E = E\ (P, Z, U^*) \qquad (3.1.4)$$

A Hicksian-compensated demand curve is a demand curve where the level of utility is constant at every point on the function. In contrast, the Marshallian demand curve allows utility to vary along the demand function. To generate the Hicksian-compensated demand function for the market goods, equation (3.1.4) can be partially differentiated with respect to a given price for the good, holding the utility constant.

$$C^* = E_p\ (P, Z, U^*) \qquad (3.1.5)$$

Since utility does not change, the change in expenditure that is necessary to compensate for the change in the good while holding utility constant, is the monetized value of utility derived from the good.

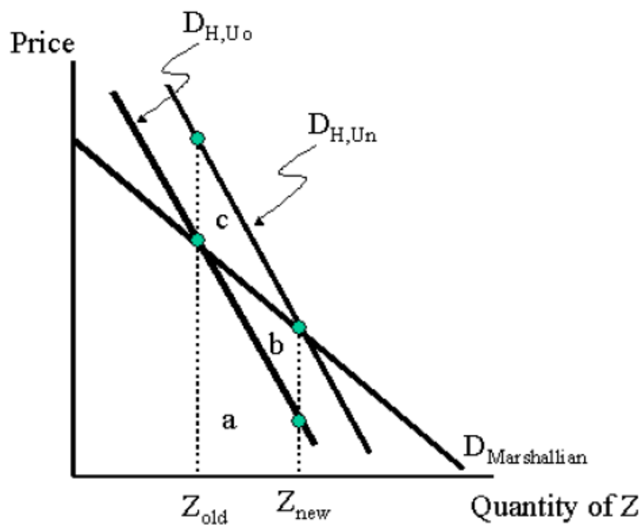

Figure 3.1 Hicksian-compensated and Marshallian-uncompensated Demand Curve

Assume that an improvement in the public good increases consumption from Q_{old} to Q_{new}. movement along the Marshallian-uncompensated demand curve result in changes in utility such as utility rises from U_0 to U_n as the price for the good falls. The consumer surplus is defined as the area under $D_{matshallian}$ or area a + b. In contrast, assuming the individual has the right to the original level of utility, then the Hicksian-compensated demand curve, $D_{H,Uo}$ is appropriate, and the monetary value of the utility is given by area a. This value, which is also known as compensating surplus, represent the payment that the individual would be willing to make that would just compensate for any change in utility from consuming the higher level of the good. If the consumer has the right to the original level of the good, then the consumer must pay for the new higher level, and hence the appropriate utility concept is compensating surplus, and hence willingness to pay for flood tax.

On the other hand, if the consumer has the right to the new level of utility, the demand curve $D_{H,Un}$ is the appropriate reference, and the area a + b+ c represents the equivalent surplus. Therefore, if the consumer has the right to the new level of utility, then the appropriate surplus measure is equivalence surplus, and hence the consumer must be paid to accept the old level of utility (i.e., there is a willingness to accept (WTA) the government compensation). In either, the individual is equally well off at either level of consumption.

Both equivalence and compensating surplus measures can be evaluated through equation (3.1.5) depending on the reference level of utility (Thunberg, 1988). To generate the Hicks-compensated inverse demand function for the nonmarket good, equation (3.1.4) is differentiated with respect to Z. According to Mishan, 1967, this is the theoretically appropriate surplus measure for welfare comparisons. It will be further argued that WTP, rather than WTA is the correct measure in this application (Michell and Carson, 1993).

$$m^* = E_z(P,Z,U^*) \tag{3.1.6}$$

In term of money income transfer required to maintain the household's utility at U*, equation (3.1.6) gives the marginal WTP for the change in the level of Z. The benefit to the individual for a change in Z is therefore given by

$$WTP = \int_{Zold}^{Znew} E_z(P,Z,U^*)dZ \tag{3.1.7}$$

3.1.3 Discrete Choice Contingent Valuation Question Format: Single Bounded Format

There are different ways to elicit WTP responses such as a modified open-ended (OE) approach and the discrete choice (DC) approach. The simple OE approach asks respondents to place their highest value on the project being described. This method is appropriate if the respondent has some experience valuing the good in question. The DC approach derives WTP estimates from a logistic model in which respondents indicate whether they would vote in favor of a project if it were presented in a referendum at a randomly chosen bid-price. In readiness for our CVM study, our questionnaire survey was based on a single-bounded format was originally developed by Hanemann, Loomis and Kanninen (1991). There is some empirical and theoretical evidence that this format is quite efficient. Actually, with a given number of interviews, more information on the distribution of willingness to pay is obtained, and this information therefore reduces the variance of the estimates of mean willingness to pay (WTP). This format firstly asked each respondent randomly whether he or she would be willing to pay a specified amount of money to gain the environmental change in question. In this case, our study asked the working population whether they would like to pay fixed amount as part of their income to support government flood control project. If a respondent answered yes, that person indicated a WTP that was higher than or equal to the specified sum. If the response was no, then that sum of money could be taken as an upper bound on their true WTP. This is defined as “single-bounded format”. Despite this respondents had been given randomly to different subsamples; however; each subsample was asked to answer to a different amount of tax payment. Nevertheless the design of the prices offered to subjects is a key consideration. If the range of offers is too low, the estimated mean WTP will be biased downward due to the lack of information from respondents who would likely answer yes (Alberini,1995).

3.1.3.1 The Single-Bounded Model

In the single-bounded survey, respondents are faced with one bid value to which they can respond with either a ‘*yes’* to accept that they are willing to pay the proposed amount, or a ‘*no’* which means they refuse to pay the proposed amount. The probability of obtaining a ‘yes’ or ‘no’ response can be represented by

$$Prob\ (no) = \mu^n = G\ (BID;\ \theta) \qquad (3.1.8)$$

$$Prob\ (yes) = \mu^y = 1 - G\ (BID;\ \theta) \qquad (3.1.9)$$

where $G\ (BID;\theta)$ is some statistical distribution function with parameter vector θ, which can be estimated using a qualitative choice model such as the logit model. The logit mode can have two forms, the log-logistic cumulative density function

$$G\ (bid) = 1/[1 + e^{a-b(\ln bid)}] \qquad (3.1.10)$$

or the logistic cumulative density function,

$$G\ (bid) = 1/[1 + e^{a-b(bid)}] \qquad (3.1.11)$$

where $\theta = (a,b)$ and a and b are the intercept and slope coefficients to be estimated. Hanemann (1984) pointed out that this statistical model can be interpreted as a utility maximization response within a random utility context, where $G\ (BID;\theta)$ is the cumulative density function of the individuals' true maximum WTP because utility maximization implies that an individual will say '*yes*' to *BID* only if *BID* is less than or equal to his maximum WTP, and will say '*no*' if *BID* is greater. The most commonly used technique for estimating the logit model is maximum likelihood (ML) estimation (Lee, 1997). In a case where there are N respondents, let BID_i be the bid offer to the i^{th} respondent. The log-likelihood function for this set of responses, following Hanemann et al. (1991) is

$$\begin{aligned} lnL^s(\theta) &= \Sigma^N_{i=1}\{d^y_i ln\ \theta^y(Bid_i) + d^n_i ln\ \theta^n(Bid_i)\} \\ &= \Sigma^N_{i=1}\{d^y_i ln[1 - G(Bid_i;\ \theta)] + d^n_i lnG(Bid_i;\ \theta)\} \qquad (3.1.12) \end{aligned}$$

where d_i^y is one if the i^{th} response is '*yes*' and zero otherwise, whereas, d_i^n is one if the i^{th} response is '*no*' and zero otherwise. This estimator is consistent (though it may be biased in small samples) and asymptotically efficient

3.1.3.2 The Pros and Cons of the Single-Bounded Format

Either single or double bounded format has its own advantages and disadvantages. For any given sample size, survey costs probably tend to be higher for the double bound model, since the interactive procedure requires that the interview is made on the spot, either face-to-face or over the telephone. If a specific member of the household is the target of the interview, for example the head of the household, contacts may be difficult or expensive, both in term of time and money. Furthermore, Herriges and Shogren (1996) found that the response rate decreases when follow-up questions are introduced in the survey. It might be possible that the additional complexity of the questionnaire may discourage survey response, directly reducing the efficiency gains from follow-up question and increasing the potential for non-response bias.

In addition, lack of time to think might have an impact on the validity of the answers obtained through the double bound process. Whittington (2002) found that giving respondents' time to think had a clear influence on their answers, producing consistently lower estimates. From this point of view, the single bound model would be more suitable. Unlike the double bound approach, the single bound option allows mailing of the questionnaires together with the relevant informative material. Respondents can take their time to answer, which should help to decrease the non-response rate.

On the account of content validity, the double-bounded format nonetheless has some difficulties because the offer of the good at a second bid price ruins the incentive compatibility of the discrete choice question, while single bounded format has been considered as incentive compatibility. Therefore, the actual outcome principally depends on how respondents interpret the new information they have just received. To illustrate, the second bid offer could create uncertainty about what the actual price to be charged will be. The individual then will respond differently due to this uncertainty. In other words, the person might interpret the second bid price as signaling that the agency is willing to bargain about the price. So the individual might provide a "*no*" answer in the hope that an even lower offer will be forthcoming (Freeman, 2003: 181-182). There are, in addition, several explanations on this for example the respondents, who firstly answered "*yes*", might feel they are being exploited when asked to pay an even higher amount.

In fact, an essential problem is that the respondent's expectations have been varied after the first question. At first, assuming no untoward strategic behavior, the respondent has no reason to believe that the first question will be followed by a second question. When the second question is asked, the respondents may doubt whether another will follow, and might adjust their responses strategically. Hence this is an obvious strategic behavior on the following-questions (Haab and McConnell, 2002: 124). In spite of this, using the double-bounded format has a trade-off between bias and variance, but this trade-off still has not been well characterized. So it would be a question for a future research. Our study in short measured the welfare values from both "single-bounded" and "double-bounded" formats because the former has been principally regarded as "incentive compatible" while the double bounded model is very statistically efficient.

Double-bounded format has a distinct advantage over other WTP formats because it not only increases the information gained from each respondent, but also raises the statistical efficacy of welfare estimation in three ways. First, the answer sequences yes-no (YN) or no-yes (NY) yield obviously clear bound on WTP. Second, as regards the no-no (NN) pairs and the yes-yes (YY) pairs, there are also efficiency gains because of a follow-up question. Last, the number of responses is raised, so that a given function is fitted with more numbers of observation (Haab and McConnell, 2002: 115).

However, from empirical study (Pinucia, 1988), differences of efficiency between single bound and double bound method tend to reduce by increasing the sample size, and are often negligible for medium size samples. On the contrary no relevant differences can be found in point estimates of parameters and central tendency measures between the two models, even for small sample size, and no estimator can be said to be less biased than the other. Therefore, the use of single bound model whenever the sample size is large enough, and the pre-test conducted on a small population sample is thought to give a good priori for the bid design of the survey. If instead the sample size is very small, or the pre-test survey is not much reliable, it is advisable to use the double bound model.

3.1.4 Estimation of Mean Willingness to Pay (WTP) in General

Our study will estimate the mean WTP from single bound formats. The WTP function is

$$WTP_j = x_i'\beta + \varepsilon_j \tag{3.1.13}$$

$$P\ [Yes] = P\ [WTP_j > B_j] = 1 - F_c\ (B_j) \tag{3.1.14}$$

where WTP_j is the true individual willingness to pay, which is assumed to depend on individual socioeconomic characteristics contained in the vector x_i'. The error term ε_i is distributed with c.d.f. $F(\varepsilon_i)$ with zero mean and variance equal to v^2. In this model WTP_j is considered a latent continuous censored variable: the observed variable is the answer *YES* or *NO* to the question regarding whether or not the individual would be willing to pay for flood tax in exchange for flood security. Given these, the log-likelihood function for single bounded model is

$$InL = \Sigma^{n}_{i=1}\{I_i \, log[1\text{-}F((t_i - x_i'\beta)/ \nu)] + (1\text{-}I_i)\log[F((t_i - x_i'\beta)/ \nu)]\} \qquad (3.1.15)$$

where I_i is a dummy variable assuming value one if the answer is positive, zero otherwise. Since $1/v$ is the coefficient of the bid t_i and bids are varied among individuals, β and v can be estimated separately, so we have a direct estimate of the standard deviation of willingness to pay.

For the single bounded format our, mean WTP under the linear random utility model for the standard normal distribution can be defined. Let us begin the simplest utility function, a linear in income (M). For individual j the indirect utility for a certain level of our flood prevention scheme:

$$v_{ij} = \alpha_i + \mu M + \varepsilon_{ij} \qquad (3.1.16)$$

where µ is the marginal utility of money and i= 0 or 1.

This is a rather restrictive functional form, even though we can extend it somewhat by allowing for interaction terms with socio-economic characteristics. To form the probabilities of the responses we can use the utility levels for the two responses- *No* and *Yes* are

$$V_{0j} = \alpha_0 + \mu M + \varepsilon_{0j} : \textit{No} \text{ response}$$
$$V_{1j} = \alpha_1 + \mu(M - B_j) + \varepsilon_{1j} : \textit{Yes} \text{ response} \qquad (3.1.17)$$

The change in the deterministic part of the utility is $\Delta U = \alpha - \mu B_j$, where $\alpha = \alpha_1 - \alpha_0$. Thus the probability that a respondent will say *Yes* (see 3.1.27 and 3.1.28) to an initial bid B_j can be expressed as

$$P[Yes] = P[\Delta U > \eta_j] = P[(\alpha - \mu B_j \geq \eta_j)] = F_\eta(\Delta U) \qquad (3.1.18)$$

where $\eta_j = \varepsilon_{1j} - \varepsilon_{0j}$ and F_η is the CDF of η_j

So our error terms are assumed as independently and identically distributed (IID) with mean zero, which is defined as the normal distribution. Then, the WTP for flood prevention scheme is given by the following condition:

$$\alpha_0 + \mu M + \varepsilon_{0j} = \alpha_1 + \mu(M - B_j) + \varepsilon_{1j} \qquad (3.1.19)$$

Solving this, yields the following expression for individual j's WTP:

$$WTPj = \alpha + \eta_{j/}\ \mu \qquad (3.1.20)$$

We should note that WTP is a function of the random part of the utility function. Thus the distributional assumption about the error term of the utility function will have an effect on the distribution of the WTP. Also, given this linear utility function, WTP is not a function of income. As for the mean WTP or the expected value, in this case of a linear utility function for the standard normal distribution is

$E[WTPi] = E\eta\ [\alpha + \eta_j/\ \mu] = \alpha/\ \mu + E[\eta_j]/\ \mu = \alpha/\ \mu$ since $E[\eta_j] = 0$ or

The mean WTP = $\alpha/\ \mu$ (3.1.21)

Therefore our mean WTP must be non-negative but not exceed the discretionary income of a household: $0 <$ *mean* (*WTP*) $< M$ and the median WTP in this case is also α / μ.

3.1.5 The Random Utility Model

Our public demand analysis was mainly based on the random utility model log-linear in income, which originally came from the random utility theory (Hanemann, 1984: 332-341; McFadden, 1974: 105-142). The key idea behind random utility theory is that even if we assume that individuals know their utility, the researcher is unable to observe the utility or the preferences completely. From the researcher's point of view, there are random elements of the utility function which are unobservable. These unobservable elements could be individual characteristics, measurement error and/or heterogeneity of the preferences. Therefore a random element, denoted ε is introduced in the utility function (Carlsson, 2007: 1-2; Haab and McConnell, 2002: 24-26): Suppose that an individual is confronted with contingent valuation (CV) scenario, which a discrete change in an environmental good from q_0 to q_1 is proposed. Thus the indirect utility function is

$$V\,(p, q, M, \varepsilon) \qquad (3.1.22)$$

where p is a vector of prices, M is income and ε is a random disturbance. To simplify, we delete the price vector from the indirect utility function. Then, suppose that the change in the environmental good in regard to an improvement is;

$$V\,(q_1, M, \varepsilon) \geq V\,(q_0, M, \varepsilon) \qquad (3.1.23)$$

In the CV scenario, a certain bid or cost is therefore proposed. So the probability which the respondent will answer with a Yes to the suggested improvement given the bid B_j for the j^{th} individual can be written as

$$P[Yes] = P[V\,(q_1, M\text{-}B_j, \varepsilon_1) \geq V\,(q_0, M, \varepsilon_0)] \qquad (3.1.24)$$

It is vital to be aware of the assumptions that we used while we set up this probability. In that regard, we assumed that individual understands the proposed change in the environmental good, so it is capable of evaluating the effect of this change on his or her utility as well as consider the proposed bid level. Also his or her response still depends on this evaluation. Given these assumptions, we have to add more assumptions in order to be able to analyze easily. An additional general assumption is that the deterministic and stochastic parts of the utility function are additively separable, so

$$v(q_i, M) + \varepsilon_i \text{ where } i = 0 \text{ or } 1 \qquad (3.1.25)$$

With this assumption, we rewrite the probability of a Yes response in (3.1.24) with a substitute of (3.1.25), therefore

$$P[Yes] = P[v\ (q_1, M\text{-}B_j)\ -\ v\ (q_0, M) + \varepsilon_1 - \varepsilon_0 \geq 0] \qquad (3.1.26)$$

The interpretation of the above probability is that individual will respond with a Yes if the sum of the deterministic change in utility, $\Delta\ U = V\ (q_1, M\text{-}B_j) - V\ (q_0, M)$ and the difference in the errors terms, $\eta = \varepsilon_1 - \varepsilon_0$, is greater than zero. Hence the probability can be again written as

$$P[Yes] = P[\eta \geq - \Delta U] \qquad (3.1.27)$$

From probability theory, we can have

$$P[Yes] = P[\eta \geq - \Delta U] = 1 - F_\eta(-\Delta U) \qquad (3.1.28)$$

where F_η is the cumulative density function (CDF) of η. For a symmetric distribution we also have $F\ (x) = 1 - F\ (-x)$. As a result, we assume that η is symmetrically distributed, thus we can write the Yes probability as

$$P[Yes] = F_\eta(\Delta U) \qquad (3.1.29)$$

On the contrary, the probability of a No response is

$$P[No] = 1 - F_\eta(\Delta U) \qquad (3.1.30)$$

3.1.6 The Random Utility Model Log Linear in Income

At first we assumed that our utility function was logarithmic in income because we might expect WTP to be increasing in income, but at a decreasing rate. Therefore we will introduce the covariates directly in this utility function. Then,

$$v_{ij} = \beta_i z_j + \mu In M + \varepsilon_{ij} \qquad (3.1.31)$$

For individual j the indirect utility for a certain level of the public good where μ is the marginal utility of money, M is income, i= 0 or 1, z_j is a vector of socio-economic characteristic such as household characteristics, β_i is the corresponding vector of parameters, and ε_{ij} is a component of preferences known to the individual respondent but not observed by the researcher. In order to form the probabilities of the responses we can use the result from (3.1.24) to (3.1.26). The utility function levels for the two responses- No and Yes respectively are:

$$v_{0j} = \beta_0 z_j + \mu InM + \varepsilon_{0j} \tag{3.1.32}$$

$$v_{1j} = \beta_1 z_j + \mu In(M - B_j) + \varepsilon_{1j} \tag{3.1.33}$$

The change in the deterministic part of the utility is $\Delta U = \beta z_j + \mu In(1 - B_j/M)$ where $\beta = \beta_1 - \beta_0$. Using the results from (3.1.26) to (3.1.28), we have the probability that an individual will respond a Yes to a proposed bid B_j can be described as

$$P\ [Yes] = \mathrm{P}\ [\Delta U \geq \eta\ ] = \mathrm{P}[\beta z_j + \mu In(1 - B_j / M) + \eta_j \geq 0] = F_\eta(\Delta U) \tag{3.1.34}$$

where $\eta_j = \varepsilon_{1j} - \varepsilon_{0j}$ and F_η is the CDF of η.

Assumed that our error term is normally distributed $\varepsilon_j \sim \mathrm{N}\ (0, \sigma^2)$. We want to estimate the model, so we have to convert the distribution to a standard normal $\theta_j \sim \mathrm{N}\ (0, 1)$. Let $\theta = \varepsilon / \sigma$ then $\theta_j \sim N\ (0, 1)$.

The probability of a Yes response is then described as

$$P\ [Yes] = \mathrm{P}\ [\eta_j \leq \Delta U] = \varphi\ [\beta z_j / \sigma + \mu/\sigma\ In\ (1 - B_j / M)] \tag{3.1.35}$$

where $\varphi\ (x)$ is the standard normal CDF. Also the parameters are divided by the unknown scale parameter (Carlsson, 2007, Haab and McConnell, 2002). Therefore this form is called standard normal distribution or Probit estimation.

3.1.7 A General Form for the Demand Model

As has been said, our study used the random utility model log-linear in income in order to estimate the public demand for a flood prevention program. Therefore we presumed that the WTP depends on income, so this log-linear model is able to capture the income effect, while the linear utility function does not account for it (Bateman et al., 2002: 184-188). The general form of the indirect utility function in the log-linear model (3.1.32) again is

$$v_{ij} = \beta_i z_j + \mu InM + \varepsilon_{ij} \tag{3.1.36}$$

where i = 0 or 1 and for j^{th} individual (j= 1,.... 600) , μ is marginal utility of income, M is income, z_j is a vector of household characteristics such as gender, the knowledge of flood, demographic characteristics, or questionnaire variations etc , β_i is the corresponding vector of parameters, and ε_{ij} is an error term assumed to be normally distributed $\varepsilon_j \sim N(0, \sigma^2)$.

The v_{ij} is defined as the binary variable for j^{th} respondent where

v_{1j} = 1 if respondent (j) says "*Yes*" on the initial rate of tax payment (B) on WTP to support government flood control project or the state or condition that prevails when flood tax is implemented.

v_{0j} = 0 if respondent (j) says "*No*" on the initial rate of tax payment (B) on WTP to finance flood control project or the status quo. Consequently demand model has been estimated as probit model because we assumed that our error term is normal distribution, so the probability of a Yes response which implied that our flood prevention scheme is carried out, is again (3.1.35) described as

$$P\,[Yes] = P\,[\eta_j \leq \Delta U] = \varphi\,[\beta z_j/\,\sigma + \mu/\sigma\, In\,(1 - B_j\,/M)] \tag{3.1.37}$$

where φ (x) is the standard normal CDF.

3.2 Methodological Issue

3.2.1 State of Work

3.2.1.1 Focus Group

Before the questionnaire had been designed and written, our study conducted 6 focus groups, pre and post-questionnaires focus groups. Mitchell and Carson (1993) strongly advocate the use of focus group and pretesting in order to probe about their feeling and perception of physical and emotional connectedness to the flooding including the understanding of WTP questions. Each focus group normally had 5 participants. We conducted 3 pre-questionnaire focus groups with the aim of constructing a questionnaire structure including the CV scenario, the following-up questions, and payment method. Despite this, focus groups did not substitute for the main survey because the participants were not randomly selected and were too small sample to yield the reliable estimates. After the questionnaire had been drafted, we had another 3 post-questionnaire focus groups to debrief us about its contents, structure or wordings, and tax rate payments. This was a useful approach for fine-tuning the questionnaire, the survey instrument, and detecting early problems. The interviewers were carefully selected and thoroughly trained in view of low education level of respondents.

3.2.1.2 Pre-Testing

After the CVM questionnaire had been tested out by focus groups, it was then pre-tested in term of carrying out a field pilot project. The pre-test rounds were used to finalize the household questionnaire. Our pilot survey, conducted during the period from May 1-20, 2013 was done with a draft questionnaire to a sample of 100 respondents similar to the ones which would be used in the final survey and under the same conditions to be followed in the final survey. During our face-to-face pilot survey, we asked respondents to describe the meaning of each question, to explain their answers, and to state any problems and difficulties they have had regarding our draft questionnaire. This alerted us to some problems in the questionnaire design and allowed for improvements prior to the beginning of the actual survey. They are asked about their willingness to pay for flood alleviation projects including types and format of their payment. In conclusion, most participants preferred to pay for the flood mitigation program especially those who resided in the flooded areas in 2011 in form of yearly income tax. From thus, we decided on the range of yearly income tax. Added to this the pilot survey served to decide a possible range of the rate on tax payment for the maximum WTP to be used in this study’s final single bounded format payments as follows: THB 500 1,000 1,500 2,000, and 2,500 respectively. These bid amounts were randomly allocated across respondents and are based on through pre-testing of the WTP question in an open-ended format before the actual survey was carried out. The wide range of income tax payment was set during the pilot survey and was intended to try to reach both extremes of the demand continuum, for example low rate-high demand and high rate-low demand.

3.2.1.3 Survey

Our study was conducted in Bangkok, the capital city of Thailand. Even though Bangkok does not represent the whole beneficiaries from government flood control project, it is the centre of economic activities and has the highest population density in the nation which is directly affected if flooding will occurs. Our target population was taxpayers with Thai nationality aged between 20 and 60 years old who were residing and still working and also pay taxes in Bangkok. Of the total 600 sample sizes, we had randomly the face to face interviews in line with our questionnaire, single bounded format. On top of this 600 sample sizes, we still had to be prepared for the unusable WTP responses, for example non-respondents and protest zeroes by adding more 5-10% to the sample sizes.

Our sampling procedure was basically based on multistage area sampling, which did not require a complete sample frame. It was also more convenient as well as more economical than one-stage random sample when the CV survey was conducted for the large population (Bateman et al., 2002). For the first stage we sampled 6 of the districts or “khets” in Bangkok with variation of geographic characteristic where they either suffer or not suffer from flooding disaster in 2011. In this study, we selected 6 districts where they either suffer or not suffer by flood disaster in 2011. The 6 districts are named as, Chom Thong, Thung Khru (where they did not suffer from flood disaster in 2011), Thawi Watthana, Phasi Charoen, and Bang Khae districts (where they suffered from flood disaster in 2011) as the sample in the survey. Then at the second stage, within each sampled district we did a quota sample concerned with the number of population to select the number of samples such that the higher the number of population within a district was, the higher proportion we selected the number of samples within a sampled district to be.

3.2.2 Questionnaire Structure

Our survey questionnaire was composed of six sectors; 1) demographic characteristics of the respondent and the household as well as socio-economic information, 2) living place characteristics, 3) geographic characteristics, 4) experience and attitude toward flooding, 5) risk perception of flood risk, and 6) assessment of WTP for flood control program which provide more explanation for the CV scenario which is the hypothetical flood control scheme.

3.2.3 Contingent Valuation (CV) Scenario

We used a CV technique to collect primary data from the general population with regard to the public support for the flood control project scheme. The face-to-face interview survey-based method, measuring respondent's preferences, has been broadly used in the field of both health and environmental economics (Carson, 2000).

Our survey asked both males and females as part of the general population in Bangkok how much they were willing to pay in term of "yearly flood tax" for supporting flood control project scheme. The hypothetical scenario was as follows:

> Bangkok has been situated in very low-lying area which is more likely to be flooded. Damages occurred from flooding are unexpectedly more likely to be serious every year, especially flooding crisis in 2011, which gave both negatively direct and indirect effect to the victims in many aspects for example, business and household interruption causing temporary business close down and loss of job, health problem from flooding, transportation problem etc.
>
> Therefore, in order to protect and reduce the negative effect and damage caused from flooding especially in mainly economic area such as Bangkok, Government has initiated to invest the flood control project for the purpose of flood prevention which will assumingly reduce the probability of flooding for 90%.
>
> However, in the process of flood control project operation need a hugh amount of money for investment in such project. Therefore, in order to reduce government budget constraint to be spent on that particular project. Assume that government initiate to collect flood tax every year. This tax will be used in this flood control project including compensation to the flood victims and subsequent maintenance.

Afterwards the respondents were asked to state what their maximum willingness to pay for supporting this program would be, using the method of single bounded questions.

3.2.4 Payment Mechanism

As has been noted, our study asked the general population who have lived and worked in Bangkok including both males and females how much they would be willing to pay as a yearly payment for supporting the flood control project program. In this regard the distribution of the costs of this flood control project might have an important effect on people. This annual income tax payment as part of a taxation mechanism to finance the provision of this project has been considered as a fairness issue because many people expressed a preference for taxation forms (Carson et al., 1999). Tax mechanisms also provide the incentive compatibility in flood control project scheme as the public good in terms of a credible and coercive payment mechanism (Carson and Groves, 2007).

3.2.5 Elicitation Method and Bids

In order to obtain the amount of willingness to pay (WTP), our study used single bounded format to estimate the WTP for the demand on yearly support for the flood control project collected. In addition, respondents beforehand were instructed to consider their budget constraints and informed that there was no right or wrong answer. They are first asked if they would be WTP any specified positive amount of money for the project that was described to them. Payment would be made for yearly basis. If they indicated the answer to that question was no, they were asked if they would be willing to provide an explanation as to why they would not support the proposal. These responses were used to classify protest bids. Given initial rate of tax payment as THB 500, 1,000 1,500 2,000 and 2,500 per year.

Respondent answered whether a “Yes” or “No” to support flood control project after listening to our hypothetical scenario, they were asked to identify their answers by giving them many different qualifications on their responses. As for the prior work by Whittington (1988), when respondents responded “Yes, if...” with many varied reasons to their answers such as “if I have money”, “if the rate of tax payment is reduced”, or “if participation is mandatory”, all of which implied “No” in polite way. In this respect we then coded a list of the many ways a respondent might say “Yes, if” to our questionnaire as the answer of “No”.

Prior to the WTP question for the respondents, various questions were asked of the respondent so as to provide a proxy for beliefs and attitudes towards a wide range of issue related to the flooding problem, etc. In addition, respondents were asked demographic question, including their income level.

3.2.6 Data Limitation

While this survey gathers information about a multitude of variables, there are still significant pieces of relevant information missing. The major problems were technical difficulties with geographically assigning some addresses and then determining a flood risk measurement for some observations. In this study, distance to river and the average elevation of the area are used as proxy for geological variables determining for flood risk measurement. In addition, a critical determination in a WTP function is the respondents’ income. To counter this problem, a two-step procedure was employed. In the questionnaire, respondents were asked to give a rough estimate of their monthly income from all sources prior to taxes. If they refused to answer this question, then they were asked to indicate the THB range in which their income would fall. If they still refused or indicated they did not know, then the responses were separated for later analysis. As described in Pindyck and Rubinfield (1998), replacing a missing observation from a data series with its sample mean does not change the least-squares slope estimator or its variance if these missing values are random. As a result, least squares slope estimator on a variable containing zero-order missing values will still be BLUE. The zero-order approach was conducted as a two part procedure. First, those respondents who indicated their income range but did not give an exact value to the open-ended question were assigned the mean value of all other respondents in their stated income range. For the respondents who refused to give any income value, they were assigned the mean value of all respondents given in the sample.

3.2.7 Treatment of Missing Data

The problem of missing data was mitigated by the use of zero-order and first-first order missing data approaches (Pindyck and Rubinfeld, 1991). For most data, the mean of the sample from the specific survey path was used when data was missing. Respondents who failed to provide a response were coded as the scale mean and those who indicated “don’t know” were coded at the midpoint of the scale such that the midpoint is “feel neutral/don’t know”.

3.2.8 Protest Bid Identification and Correction

The treatment and identification of protest bids is not nearly as easy though. A protest bid is defined by Mitchell and Carson (1993) as respondents who offer a zero bid because they reject the evaluation process itself. Respondents appeared to protest against the imposed market constructed by the hypothetical WTP by stating reasons such as ‘I don’t believe the money will actually be spent on the flood control project’ or ‘I don’t believe the flood control project will protect me and my family” or ‘I believe that payments are too high’. Another important issue addressed in the follow-up survey is to what extent strategic bias played a role too when stating a zero WTP in view of the fact that before answering the WTP question a majority of respondents indicated that they generally expect the central government to pay for flood control project with the help of foreign aid, although no one actually protested against the proposed market and payment structure for this reason. Most floodplain residents in the original survey indicated that the central government is responsible and should pay for flood control project before answering the WTP question. None of these respondents, however, referred to this statement when they were asked to explain why they are not willing to pay for the proposed flood protection scheme. Hence, some degree of strategic bias may also have influenced the high share of zero stated WTP. Usually this biased response is included in the definition of protest response in CV research.

Distinguishing between those who actually would bid a zero and those that are true protest bids is very important. To separate these then, Mitchell and Carson (1993) suggest the survey instrument have a follow-up question for those offering a zero bid asking why they gave that amount. These can then be interpreted in the analysis to find those that potentially are protest bids. This strategy was incorporated in our survey. To account for any potential impact from these protest bids, a special dummy variable is created that equals one for protest observation and zero for all others. Including dummy variable in any regression controls for any bias introduced from these protest bids without requiring the observation be thrown out altogether.

3.2.9 The Estimation of Mean Willingness to Pay (WTP)

Our study will calculate mean WTP from single bounded formats because single bounded format can provide "fully incentive-compatible" issue and also "efficiency" if the sample size is large enough (Pinucia, 1988). On this account, we estimated the mean WTP values with regard to important aspect for the purpose of policy implication which is geographic characteristic. As for this aspect, we hypothesized that the WTP amount for this flood control project scheme would be higher for a high risk in term of location in such a way that those whose living properties are situated in the low-lying area and very close to the main river are more likely to pay for flood prevention scheme because they may have perceived that they have been more likely to suffer from flooding comparing with those respondents living in high level areas and far from the main river.

3.3 Modeling and Analysis of Our Public Demand

In readiness for flood control project scheme, we assumed that the respondents would be willing to support this scheme if it maximized their utility relative to the alternative, no national flood control project or the status quo, where utility is defined over health and other consumption goods. In addition our study put the respondent as the general population in the role of a unitary decision-maker, inquiring them to maximize their own utility function, which definitely reflected either their own benefits or altruistic preferences towards other people subject to own income or earning.

Consider an individual living in a flood prone area such as Bangkok in this study. Under conditions where no flood protection is provided, the individual's utility may be described in terms of a state-dependent utility function. Assuming that utility can be represented by a numeraire good Y, the individual's utility in a no-flood state (state one) is $U_1(Y_1)$, while in the flooded state utility is $U_2(Y_2)$. Denoting the probability of the no-flood state occurring as p, and the flooded state as (1-p), the individual's expected utility is given by:

$$E[U] = pU_1(Y_1) + (1-p)U_2(Y_2) \qquad (3.1.38)$$

The service provided by a flood control project is a reduction in the probability of a flood, or equivalently, an increase in the probability that no flood will occur. Denoting the increase in the probability that a flood will not occur as θ, the individual's expected utility under with flood protection condition may be written:

$$E\,[U] = (p + \theta)\, U_1(Y_1) + (1-p-\theta)U_2(Y_2) \qquad (3.1.39)$$

The maximum payment that an individual would be willing to make in order to avail him/herself of the increased probability of a no-flood state is defined by the decrement to income required while holding utility constant. This payment is called the option price (OP) (Smith, 1987). Thus, the option price is the maximum payment that must be made such that equations (3.1.36) and (3.1.37) with and without flood protection expected utility are equal.

$$(p + \theta)\, U_1(Y_1 - OP) + (1-p-\theta)U_2(Y_2 - OP) = pU_1(Y_1) + (1-p)U_2(Y_2) \qquad (3.1.40)$$

The option price may be thought of as being equal to an individual's willingness to pay for a flood control project that will increase the probability that a desired of nature will be realized. Thus the option price must be an expression of the gains an individual anticipates to result from a project.

Individuals expect to gain from a flood protection project through avoidance of flood damages. Flood damages are defined as the money equivalent value of any pre- or post-flood effect that an individual is willing to pay to avoid. Thus, the service flow of a flood control project may have property and non-property components. Specifically, the services to real property are the reduced expectations of future expenditures for repair and restoration of real property damaged by flooding. Non-property services from flood protection are assumed to include: 1) reduced expectations of the social and economic disruption of the community caused by a flood event; 2) reduced expectations of post flood trauma, where trauma is defined as a disordered psychic or behavioral state resulting from the emotional stress or physical injury from an experienced flood event; and 3) reduced pre-flood anxiety, defined as a disordered psychic or behavioral state resulting from a feeling of apprehension or fear over the prospect of flooding, and self-doubt about the capacity to cope with the flood threat.

3.3.1 The specific Demand Model

The application of CV to value changes in individual risk exposure is fairly widespread nowadays (e.g. John-Lee et al., 1993; Baron and Greene, 1996; Jones-Lee and Loomes, 1997; Beattie et al., 1998; Carthy et al., 1999). A money measure of a change in risk is identified, defined as a positive or negative payment, which holds expected utility constant. The higher the utility obtained from risk reductions, the greater we expect this amount to be, ceteris paribus (Johannsson, 1995). One possibility to dealing with the appropriate theoretical model of decision making under uncertainty is to employ the expected utility model, developed by Von Neumann and Morgenstern (1947). The authors argue that the rational decision maker, when faced with choices with uncertain outcomes, will maximize the expected utility of consumption. The context of decision making under uncertainty is maintained as individuals or households are assumed to from the subjective judgments over future flood event and flood consequences.

The valuation of the flood control project proposed in this study depends upon each household's subjective assessment of the flood risk, which in turn depends on proximity to the river, location of the floodplain, and other factors. It also depends on the extent to which the proposed project will impact that risk as well as local resident's perception of that risk. In general, the level of risk exposure faced by an individual depends on two main factors: an exogenous element and an endogenous element. The former refers to facts or factors, which are beyond an individual's locus of control, and the latter to the fact that people can take actions which reduce the likelihood of an undesirable event occurring (self-protection), and reduce the cost of the event to them if it does occur (self-insurance) (Shogren and Crocker, 1991). Obviously, individual risk-reducing behavior will influence the realized risk level affecting each person. In equilibrium, economic theory predicts that individuals equate the marginal benefits of self-protection/insurance (expected avoided disutility) with the marginal costs (price of self-protection/insurance), subject to their budget constraint. WTP for flood and environmental risk reduction may depend on factors such as risk perception, resource limitations, personality (individual characteristics), current risk levels, and acceptability of risks. Whether, an individual acts or not depends on whether his utility reaches a maximum, which is confined to the addresses factors.

The specific demand for flood control project scheme, whether respondents as part of the general population are willing to pay through their yearly income tax payment, depends on the rate of tax payment (R); personal monthly income (Y); household size and composition (H), in particular the total number of children living in the same household; respondent characteristics (Z) for example age, gender, marital status, occupation and education level; house characteristics (Ho) such as type, owner, structure of house including living and expected living period in their house; a vector of flooding variables (F) such as the knowledge about the causes of flooding, the awareness of flood, the respondent’s experience with flooding which also reflect the degree of risk aversion ,geographic characteristics (G) such as distance to the river and elevation of living place; risk perception and expected damage from flood (D). These dependent variables on our model will be described as follows:

$$Pr\,(WTP_{\mathrm{i}}) = f\,(R_{\mathrm{i}}, Y_{\mathrm{i}}, H_{\mathrm{i}}, \mathrm{Z}_{\mathrm{i}}, Ho_{\mathrm{i}}, F_{\mathrm{i}}, G_{\mathrm{i}}, D_{\mathrm{i}}) \qquad (3.1.41)$$

1) Rate of tax payment (R): as for five different payments, THB 500, 1,000, 1,500, 2,000 and 2,500 respectively, so we expected that a higher payment would reduce the level of demand on respondent, willing to pay for flood control project scheme when other variables must be hold constant.

2) Personal monthly income (Y): our personal income variable was an average of monthly income per person before tax expressed in logarithmic form. An

increase in income, other things being constant, will raise the level of demand if flood control program considered as a ‘normal” good.

3) Household size and composition (H): First our study asked the respondent the number of household members, so the answer was expected to be continuous as a unit of person. We hypothesized, ceteris paribus, that the greater the number of household members, the less the respondent would be willing to pay for flood control project. It implied that respondents with more household members have more difficulty with the payment for this program. So, they would conceivably be willing to pay less for supporting the scheme. Thereafter if respondents had household members living in the same house, they were then asked how many children you have. As has been said, respondents whose household contains children would be more likely to support this scheme because children are more likely to suffer the negative impact of flooding than adults. Therefore, other thing being equal, a respondent living with children in the same family is more likely to support for flood control program than the others who do not have children household members.

4) Respondent characteristics (Z): Our respondent characteristics such as age, gender, marital status, occupation and education were all incorporated into our study as the proxy for socio-economic characteristics. Only the age variable was measured in continuous data as the unit of year, while gender, marital status, occupation and education were measured by dichotomous variables for gender: male and female; the different types of marital status; single, married, and divorced/ widow/separated; occupation: public and private; and the varied level of completed education (elementary: 1-6 years of schooling; primary: 1-9 years of schooling, secondary: 12 years of schooling, university, postgraduate, vocational, and no schooling). As for varied educational levels, our study rearranged them into two different levels: the low educational level was where respondent had completed education below university degree such as primary, secondary, or vocational, as well as no schooling where the respondent has never attended school, while the upper education level was a respondent whose academic level was at least a university degree, this includes person who already completed a postgraduate or a professional course such as medical degree. As a consequence, our educational level variable was either high and low education. It is generally observed that individuals with a high

education level have a higher perception of risk, hence would tend to pay more on this flood prevention scheme. Some studies indicate that age and gender may also affect perception of hazard risk. Moreover, women perceive risk differently than men and are often more likely to view disaster events and natural hazards as risky.

5) House characteristics (Ho): These variables include type, owner, structure of house including living and expected living period in their house. For ownership of the house, this takes on a value of 1 if the respondent answered that they owned their dwelling and 0 otherwise. If the person owns their house, then they should be willing to pay more to prevent flood damage to it than other who rent. For living period in their house, each respondent was asked how many years they had lived in their current household. The responses to this question are continuous; as they could specify the exact number of years they had lived. The longer a person has lived in the same residence, the more protective they should be of it and the higher their civic pride, so the higher their WTP amount. For housing material prospective, living places made of wood are more likely to suffer flood damages than placed made of other flood-resistant material such as cement, therefore the more positive WTP.

6) Experience, and awareness of flooding (F): the flood related questions are aimed at examining the extent and the nature of impacts of flooding on life and livelihood including any health related impacts and damage costs. The questionnaire included three questions relating to experience. It was asked whether the individual has ever experienced a flood in their living area. If the individual has experienced a flood then it was inquired whether any damage was suffered. Finally, it was checked whether the individual was ever evacuated because of threat for flooding. However, there are some respondents actually did not suffer damage because of flood, so that this variable cannot be used in the statistical analysis. Therefore, we decided to include a variable representing respondents who indicate that they have both experienced a flood in their living area and have been evacuated because of a flood threat. The concrete experience with flooding is likely to affect the perception of the risk. A variable has been created representing individual who cannot state the causes of flooding event. It is relevant to examine how this lack of knowledge about floods determines risk perceptions. For example, in case less knowledge individuals have

lower perceptions of flood risk then a campaign providing information about floods may be effective in terms of increasing awareness.

7) Geographical characteristics (G): our geographic characteristics are the difference between the elevation area of the respondent, the distance of the house to a main river and whether the respondent lives in an area that is not protected by dikes. The explanatory variable capturing the relative elevation of the location can be used as an indicator of potential flood damage. The lower the location of an area, the higher is the potential water level during a flood. The variable of the distance of the individual's house to a main river is another indicator of potential flood damage in addition to the elevation of the house. This variable may also reflect a higher probability of flooding. Houses near a river are more likely to suffer flood damage than houses far away from a river.

8) Risk perception and expected damage from flooding (D): risk perceptions of flooding may provide important information about individual decision to publicly support for government flood mitigation policies. Financial support by individuals for risk reducing investments is stronger, reflected in term of positively higher WTP, if the risk perception may further perceived as great by citizens. Theoretically, expected risks are consistently related to actual risk level, since individuals in the vicinity of a main river and low-lying areas generally have elevated risk perception. Individual risk perceptions may be related to the degree of financial risk aversion of the individual.

As regards in Table 3.1, our log-linear model had been more described are as follows. With the use of diverse econometric packages such as Eviews 4.0, STATA 10.0, our study estimated these log-linear models as the function of probit model because we assumed that *Pr* (WTP_{ij}*) is a normally distributed random variable, so that the probability that WTP_{ij}* is less than or equal to WTP_{ij} can be computed from the cumulative normal probability function. The standardized cumulative normal function is written as F (WTP_{ij}) = $F\left(WTP_{ij}\right) = \frac{1}{\sqrt{2\pi}}\int_{-\alpha}^{WTP_{ij}} e^{\frac{-s^2}{2}ds}$ where s is a random variable which is normally distributed with mean zero and unit variance. Most commonly the parameters in probit model are estimated by the method of maximum likelihood. Although maximum likelihood estimator has the property of being consistent, there are two major problems: heteroskedasticity and misspecification causing this maximum likelihood method become inconsistent. First, heteroskedasticity problem has occurred when the assumption of constant error variance (homoskedasticity) is unreasonable or the error variance is unequal. Because of this we at first had to test for heteroskedasticity in our probit model by Lagrange multiplier (LM) test with the binary response model regression or BRMR. Second probit model is usually sensitive to misspecification problem, which reflects heteroskedasticity or non-normality of standard error term, so our study will use "robust variance estimators", which is known as Huber, White, or sandwich standard errors to guard against the misspecification problem (Greene, 2008).

With the assumption on probit model, the cumulative distribution function (CDF) must follow the normal distribution. In order to use this probit model, we had to test whether our model was normality or not. Our study hence referred to "central limit theorem" such that if sample size n is large (often in excess of n = 30), then standardized variable $Z = \frac{X-\mu}{\sigma/\sqrt{n}} \sim N(0,1)$ regardless of the form of the discrete probability density function (PDF), has approximately a standard normal (Z) distribution. Due to the large sample size in our study, our model had been qualified for the assumption of normality in the probit model.

To interpret coefficients or results in probit model, it unlike other regression models is not so straightforward to obtain a marginal effect interpretation. In spite of this, it is possible to obtain something akin to a marginal effects interpretation, except in terms of the probability. This is, the conventional regression marginal effect interpretation in sample regression in general is: 'How much dose Y as dependent variable change when you change X as independent variable?', and β then is the answer to this. With qualitative choice model like probit, we altered this to: 'How much does the probability of making choice 1 change when you change X?', however it is not simply β which is the answer to this (Koop, 2008). As a result we used STATA 10.0 command called mfx to estimate the marginal effect of X on the probability of these respondents will say "yes" on their willingness to pay on the a specific income tax payment to support flood mitigation program. Therefore the marginal effect in general is written as $\frac{\partial E[Y/X,\beta,\Omega]}{\partial X_i} = f(X,\beta,\Omega)\beta_i$ where X is the independent variables, β is the coefficient and Ω is some distribution. So the marginal effect is the coefficient multiplied by some scale factor f (X, β, Ω).

Lastly, the measurement on a goodness-of-fit is a summary statistic indicating the correctness with which the model approximates the observed data, like the R^2 measure in the conventional linear regression model. In this case in which our dependent variable is qualitative, accuracy might be judged either in terms of the fit between the calculated probabilities and observed response frequencies or in terms of the model's ability to forecast observed responses. Unlike the linear regression model, there is no universally accepted goodness-of-fit measure for probit model (Kennedy, 2008: 249; Veerbeek, 2008: 205-207). Therefore our study with the use of STATA 10.0 will provide various measurements in terms of two different measures: i) log-likelihood based measures such as Pseudo-R^2, and ii) information measures, for example Akaike's information criterion (AIC), the Bayesian information criterion (BIC), respectively. Then chapter 4, the next chapter, provided a detailed description on our survey as well as a detailed analysis on our results with interpretations on this survey study.

Table 3.1 The Description of Variables in the Probit Model with their Expected Signs of Coefficient

Variable	Description	Expected sign
Independent variable		
Rate	Rate of tax payment (Logarithm form, baht) : 500, 1,000, 1,500, 2,000, 2,500	Negative
Personal income		
Income	Personal monthly income (continuous in logarithm form, baht)	Positive
Demographic and socioeconomic		
Male	Gender = 1 if male, 0 otherwise	Negative/Positive
Age	Age of respondents (continuous, years)	Negative/Positive
Married	Marital status = 1 if married, 0 otherwise	Negative/Positive

Table 3.1 (Continued)

Variable	Description	Expected sign
Education	Education level = 1 if respondent completed at least university, 0 otherwise	Positive
Private	Occupation status = 1 if public, 0 otherwise	N/A
Household	Number of household members (continuous, persons)	Negative
Children	if 1 = respondent has children living in the same household, 0 otherwise	Negative/Positive
Living place characteristics		
Type	if 1 = having more than the 1st floor, 0 otherwise	Negative
Flood Sensitive	if 1 = house made of flood sensitive materials, 0 otherwise	Positive
Expected	if 1 =no plan to sell the property within 5 years	Positive
Ownership	if 1 = own the house, 0 otherwise	Positive
Damage from flood (Proxy by cost of flood prevention)		
Expense	Continuous variable, Cost of flood prevention in 2011 in unit of Baht	Positive
Geographic characteristics		
River	if 1 =directly affected relative to distance	Positive
Area	if 1 = situated in low-lying area, 0 otherwise	Positive
Awareness and experience of flooding		
Exp	if 1 = have experienced and have been evacuated of flood disaster in 2011, 0 otherwise	Positive
Risk	Categorical variable, level of perceived flood risk on property from 1-5	Positive

3.3.2 Other Used Methods

In this study, we also used preventive expenditure model with ordinary least square (OLS) and tobit function to estimate mean willingness to pay (WTP) for flood prevention expenditure occurred in the flood disaster in 2011 in order to compare with

WTP for flood tax to support flood prevention scheme for consistency and compatibility.

3.3.2.1 Preventive Expenditure Model

There are three kinds of method to estimate unpriced values, namely those based on (i) demand and willingness to pay, (ii) supply and costs of protection, and (iii) market prices. Market prices rarely exist for environmental services or their associated goods and services, so this review concentrates on demand and supply-based methods.

The cost methods interpret expenditures on the supply of environmental services, to derive the benefit values implicit in the expenditures. There are many different kinds of expenditure involved in the provision of flood tax, including the costs of directly protecting the house from flooding. This method is based on actual costs and so should provide reliable values, but is likely to give minimum estimates of benefits.

The defensive behavior approach infers peoples' WTP to reduce or avoid exposure to flooding from the amounts of money they spend on precautionary action taken. Individual households or firms often act to maintain the existing level of utility or profit. They might, for example, buy sandbags against flooding to protect their house. The benefit of such actions must exceed the cost, otherwise they would not be undertaken, and hence the intuitive appeal of the method. Defensive expenditures are those made to protect against the impacts of environmental degradation. These may be understood as a lower bound (or minimum estimate) on the cost of pollution and willingness to pay for preventing it.

3.3.2.2 The Theoretical Model

The theory to apply these beliefs can be presented first from the standpoint of consumer who seeks to maximize utility (Shortle and Abler, 2001).

$$U = U(e,q) \qquad (3.1.42)$$

With respect to the income constraint

$$Y = D(e) + p.q \qquad (3.1.43)$$

Where U is utility, e is environmental quality, q is the quantity of all non-environmental goods and services that are consumed, p is the price of those goods and services, D (e) is the defensive expenditure function that defines the necessary costs to “consume” the environmental quality, and Y is income.

The benefit from defending a given environmental quality against an adverse change is equal to the extra income (EV) that would be required to restore the consumer’s utility back to its original level, after the adverse change has occurred. In estimating this measure of Hicks equivalent variation, the utility before the change must equal the utility after the change:

$$U(Y_0, e_0) = U(Y_1, e_1) \quad (3.1.44)$$

Where e is the level of environmental quality before (0) the change and after (1) the change. The ideal measure of defensive expenditures in term of consumption (DE_c) is therefore the change in income that restores the original level of utility. So from equation (3) we have:

$$DE_c = (Y_1 - Y_0) = EV \quad (3.1.45)$$

This concept of the benefit is hard to measure when the demand for the environmental quality is hard to estimate, and when the observable data do not capture any change in demand that follows the change in environmental quality.

A minimum bound to the benefit can be estimated from the costs necessary to maintain the level of environmental quality rather than from the extra income necessary to maintain the level of utility. This minimum (DE_{cm}) is the expenditure necessary to maintain the initial level of environmental quality (e_0) before and after the change. For the consuming household and following Shortle and Abler (2001):

$$DE_{cm} = D(e_0, w_0) - D(e_0, w_1) \quad (3.1.46)$$

where e0 is the quality of the environment that is to be maintained.

The defensive expenditure method is based on the assumption of perfect substitution. If the w and f are perfect substitutes, a value of a change in environmental quality can be estimated by estimating the resulting change in the demand f. Therefore, equation (5) can also be derived through the production measure to be undertaken to guard against the loss from flooding. The defensive expenditure (DE_p) is now the cost of the extra inputs needed to maintain the initial environmental quality after the potential flooding.

$$DE_p = D(e_0, f_0) - D(e_0, f_1) \qquad (3.1.47)$$

where e0 is the initial level of environmental quality, the flooding prevention expenditure f. This approach requires only information on the defensive expenditure function D (e,f), and the management actions before and after knowledge of the flooding.

3.3.2.3 Tobit Model

The tobit model is a statistical model proposed by James Tobin (1958) to describe the relationship between a non-negative dependent variable y_i and an independent variable xi. The tobit model can be described in term of a latent variable y^*. Suppose, however that y_i^* is observed if $y_i^* > 0$ and is not observed if $y_i^* \leq 0$. Then the observed y_i will be defined as

$$y_i = \begin{cases} y_i^* = \beta x_i + \mu_i & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases}$$

$$\mu_i \sim IIDN(0,\sigma^2)$$

This is known as the tobit model. The tobit model, also called a censored regression model, because some observation on y_i (those for which $y_i^* \leq 0$) are censored. In other words, the latent variable y_i^* is observed only if $y_i^* > 0$. In particular, the actual dependent variable is y = max (0, y^*). For example, in this case, let y be the amount of money that an individual spends on flood prevention in 2011, given his or her characteristics x. Then y > 0 if the individual perceived the flood risk and spent money to buy sandbags, water pumps or others for the purpose of flood prevention, and y = 0 if not.

3.3.2.4 The General Model

The analytical task is to identify the way the cost of flood protection varies with these different characteristics of variables, including geographical characteristics, experience with and knowledge about the risk and socio-economic and demographic characteristics. The following general function, which models the supply function, was therefore specified.

Expense = f (Personal income, Demographic and socioeconomic, Living place characteristics, Geographic characteristics, Awareness and experience of flooding)

As seen the above function, the independent variables to be used in OLS and tobit function in preventive expenditure model are same as the variables used in the WTP for flood tax in probit function except Expense variable which, in the probit model treated as independent variable, is treated as dependent variable, instead.

Table 3.2 The Description of Variables in the OLS and Tobit Model with their Expected Signs of Coefficient

Variable	Description	Expected sign
Independent variable		
Personal income		
Income	Personal monthly income (continuous in logarithm form, baht)	Positive
Demographic and socioeconomic		
Male	Gender = 1 if male, 0 otherwise	Negative/Positive
Age	Age of respondents (continuous, years)	Negative/Positive
Married	Marital status = 1 if married, 0 otherwise	Negative/Positive
Education	Education level = 1 if respondent completed at least university, 0 otherwise	Positive
Private	Occupation status = 1 if public, 0 otherwise	N/A

Table 3.2 (Continued)

Variable	Description	Expected sign
Household	Number of household members (continuous, persons)	Negative
Children	if 1 = respondent has children living in the same household, 0 otherwise	Negative/Positive
Living place characteristics		
Type	if 1 = having more than the 1st floor, 0 otherwise	Negative
Flood Sensitive	if 1 = house made of flood sensitive materials, 0 otherwise	Positive
Expected	if 1 =no plan to sell the property within 5 years	Positive
Ownership	if 1 = own the house, 0 otherwise	Positive
Geographic characteristics		
River	if 1 =directly affected relative to distance	Positive
Area	if 1 = situated in low-lying area, 0 otherwise	Positive
Awareness and experience of flooding		
Exp	if 1 = have experienced and have been evacuated of flood disaster in 2011, 0 otherwise	Positive
Risk	Categorical variable, level of perceived flood risk on property from 1-5	Positive

CHAPTER 4

EMPIRICAL RESULTS

4.1 Profile of Respondent

A total of 600 individuals who are currently working and living in Bangkok aged 20-60 years were successfully interviewed during the period from May to November 2013. The response rate for individuals was 85%, but only 15% were non-responses. Our study compensated for these by adding more survey interviews to obtain the completed number of 600 survey interviews. On this account we described the profile of respondents as follows: 1) Socio-demographic characteristics; 2) Geographic characteristics including living place characteristics; 3) Awareness and experience of flooding in 2011 and 4) Willingness to pay for a flood prevention program.

4.1.1 Socio-Demographic Characteristics

Of the 600 people randomly selected in Bangkok survey, the majority of respondents were female (51.5%) with an average age of 32 years, and marital status was married (41.5 %). More than half of the respondents (62.5%) had completed at least a university degrees as well as being employed (78%) in the private sector. The average household size was 2.8 persons (Table 4.1).

Table 4.1 Socio-Demographic Characteristics of the Respondents

Variable	**Descriptive**	**Mean**	**S.D.**
Rate	Rate of tax payment (Logarithm form, baht)	7.17	0.25
Income	Personal monthly income (continuous in logarithm form, baht)	9.77	0.46
	Personal monthly income (continuous baht)	22366.43	16988.54

Table 4.1 (Continued)

Variable	Descriptive	Mean	S.D.
Male	Gender = 1 if male, 0 otherwise	0.485	0.50
Age	Age of respondents (continuous, years)	31.97	5.26
Married	Marital status = 1 if married, 0 otherwise	0.415	0.49
Education	Education level = 1 if respondent completed at least university, 0 otherwise	0.625	0.48
Private	Occupation status = 1 if public, 0 otherwise	0.22	0.42
Household	Number of household members (continuous, persons)	2.86	1.04
Children	if 1 = respondent has children living in the same household, 0 otherwise	0.52	0.77

Since the target population in our study in Bangkok aged 20-60 years old therefore, we had to compare our sampling data with the target population in order to verify whether our survey sample can accurately and reliably be extrapolated to the entire population.

Table 4.2 The Comparison between Sampling Results and Target Population

	Our sampling results	**"Target population: Bangkok Metropolitan area"**
Male	0.485	0.464
Female	0.515	0.536
Age	31.97 yrs	32.50 yrs
"Number of household member"	2.86 persons	3.29 persons
Monthly income (before tax)	22,366.43 baht	22,021.39 baht

Source: National Statistic Office, 2013.

Table 4.2 shows the comparison between our sample and the target population. In this regard, gender, age, the number of household members, and monthly income in our sample, for instance, had almost the same average number as the target population. Of the target population aged 20-60 years old in Bangkok, females who were income earners had a slightly higher proportion than males. On average people in Bangkok metropolitan area were almost 33 years old with an approximate monthly income of 22,000 baht and had 3 members in their households. Consequently our results were an appropriate sample, representing this target population of Bangkok.

4.1.2 Geographic Characteristics and Living Place Characteristics

For living place characteristics, 48% of survey respondents owned their houses or living places. In more detail, 75% of survey respondents had the living place composing more than 1st floor and with 23% of respondents' living spaces, they are made of flood sensitive material such as wood. Moreover, with 76% of respondents, they had no plan to sell their property within 5 years.

For geographic characteristic in term of height and distance to the main river, 44% of respondents' living spaces are affected by flooding relative to distance to the main river. In term of height, 55% of respondents, they perceived their houses were situated in low lying areas. In addition, when matching perceived AREA variable with reliably geographic data, it was found that 89% of the respondents who perceived their houses were situated in low lying area were geographically situated in the area of 0-1 meter height while 92% of the respondents who perceived their houses were situated in high lying area were geographically situated in the area of 1-2.5 meter height. In more detail, in term of reliably geographical data in each particular area, 32% of respondents' living space was situated in the area of 1.5-2.5 meter height such as in Chom Thong and Thung Khru districts, 8.3% of respondents' living space was situated in the area of 1-2 meter height such as in Thawi Watthana district, 43% of respondents' living space was situated in the area of 0.5-1 meter height such as in Phasi Charoen and Bang Khae districts and 17% of respondents' living space was situated in the area of 0-0.5 meter height such as in Nong Khaem district.

Table 4.3 Geographic Characteristics and Living Place Characteristics

Variable	Descriptive	Mean	S.D.
Type	if 1 = having more than the 1st floor, 0 otherwise	0.75	0.44
Flood Sensitive	if 1 = house made of flood sensitive materials, 0 otherwise	0.23	0.42
Expected	if 1 =no plan to sell the property within 5 years	0.76	0.43
Ownership	if 1 = own the house, 0 otherwise	0.48	0.50
River	if 1 =directly affected relative to distance	0.44	0.50
Area	if 1 = situated in low-lying area, 0 otherwise	0.55	0.50
Area1	if 1 = situated in area of 1.5 - 2.5 meter height , 0 otherwise	0.32	0.02
Area2	if 1 = situated in area of 1 - 2 meter height , 0 otherwise	0.083	0.01
Area3	if 1 = situated in area of 0.5 - 1 meter height , 0 otherwise	0.43	0.02
Area4	if 1 = situated in area of 0 -0.5 meter height , 0 otherwise	0.17	0.02

4.1.3 Awareness and Experience and Expense of Flooding

Of 600 respondents in our survey, with the scale of 1-5, respondents perceived flood risk on their average of 3.24 which was above the medium point. It means that they were aware of flood risk to their property and their livelihood.

As regards experience of flooding occurrence, 65% of respondents had experienced and had been evacuated of flooding disaster in 2011. In addition, the average expenditure of flood in 2011 was 4,618.67 baht.

Table 4.4 Awareness, Experience and Expense of Flooding in 2011

Variable	Descriptive	Mean	S.D.
Exp	if 1 = have experienced and evacuated of flood disaster in 2011, 0 otherwise	0.65	0.48
Risk	Categorical variable, level of perceived flood risk on property scaled from 1-5	3.24	1.56
Expense	Expenditure for flood prevention in 2011 (continuous baht)	4618.67	5177.7

Moreover, from the questionnaire, we also asked the respondents in detail about the types of the effects in many aspects they encountered in the flood event in 2011. The results are as follows;

Table 4.5 Levels of Effect Received in 2011 Flood Event

Effects	Levels of effect received in 2011 flood event						Total
	Very high	High	Not high/not low	Low	Very low	No effect	
1. Life effect e.g. drawn injury	171 (28.5)	181 (30.2)	202 (33.7)	19 (3.1)	14 (2.3)	13 (2.2)	600 (100)
2. Health effect e.g. Leptospirosis, Intestine disease, Diarrhea, Cholera	262 (43.7)	248 (41.3)	61 (10.2)	7 (1.2)	10 (1.7)	12 (1.9)	600 (100)

Table 4.5 (Continued)

Effects	Levels of effect received in 2011 flood event						Total
	Very high	**High**	**Not high/not low**	**Low**	**Very low**	**No effect**	
3. Economic effect e.g. expense for repairing , Loss of income, Flood preventive expenditure	321 (53.5)	195 (32.5)	50 (8.4)	17 (2.8)	10 (1.7)	7 (1.1)	600 (100)
4. Psychological effect e.g. stress	334 (55.7)	187 (31.2)	56 (9.3)	8 (1.3)	7 (1.2)	8 (1.3)	600 (100)
5. Asset effect e.g. loss of asset while flooding	261 (43.5)	196 (32.6)	115 (19.1)	13 (2.2)	9 (1.5)	6 (1.1)	600 (100)
6. Scenery effect e.g. bad smell, polluted water	184 (30.7)	188 (31.3)	136 (22.6)	44 (7.3)	29 (4.9)	19 (3.2)	600 (100)

By asking the respondents to prioritize with the scale of 1-6 regarding to the types of the effects in many aspects they encountered in the flood event in 2011, the results are as follows;

For life effect, 28.5 % of interviewed respondents considered this effect as very important, while 30.2 % considered as high, 33.7 % considered as not high/not low, 3.1 % considered as low, 2.3 % considered as very low and 2.2 % considered as no effect any more.

For health effect, 43.7 % of interviewed respondents considered this effect as very important, while 41.3 % considered as high, 10.2 % considered as not high/not low, 1.2 % considered as low, 1.7 % considered as very low and 1.9 % considered as no effect any more.

For economic effect, 53.5 % of interviewed respondents considered this effect as very important, while 32.5 % considered as high, 8.4 % considered as not high/not low, 2.8 % considered as low, 1.7 % considered as very low and 1.1 % considered as no effect any more.

For psychological effect, 55.7 % of interviewed respondents considered this effect as very important, while 31.2 % considered as high, 9.3 % considered as not high/not low, 1.3 % considered as low, 1.2 % considered as very low and 1.3 % considered as no effect any more.

For asset effect, 43.5 % of interviewed respondents considered this effect as very important, while 32.6 % considered as high, 19.1 % considered as not high/not low, 2.2 % considered as low, 1.5 % considered as very low and 1.1 % considered as no effect any more.

For scenery effect, 30.7 % of interviewed respondents considered this effect as very important, while 31.2 % considered as high, 22.6 % considered as not high/not low, 7.3 % considered as low, 4.9 % considered as very low and 3.2 % considered as no effect any more.

4.1.4 Other Relevant Information

Apart from the above information necessary for statistical analysis, in the survey, we included the questions regarding two relative respondents’ aspects which were, first, the required assistances provided by government before and after the flooding event in order for government to improve assistance when the flooding will occur next time and second, the important flood protection measures to be included in the flood control project required by the interviewed respondents for further development of flood control project by government.

4.1.4.1 The Required Assistances Provided by Government

By asking the respondents to prioritize with the scale of 1-6 regarding to the necessary assistances requested from the government in case of flooding, the results are as follows;

For providing updated information and accurate warning system, 31.5 % of interviewed respondents considered this assistance as very important, while 40.6 % considered as high, 21.4 % considered as not high/not low, 2.8 % considered as low, 1.1 % considered as very low and 2.9 % considered as no effect any more.

For giving instruction for flood preparation, 22.3 % of interviewed respondents considered this assistance as very important, while 40.9 % considered as high, 29.7 % considered as not high/not low, 3.1 % considered as low, 1.9 % considered as very low and 2.1 % considered as no effect any more.

For providing sandbags for flood prevention, 40.8 % of interviewed respondents considered this assistance as very important, while 34.2 % considered as high, 19.1 % considered as not high/not low, 2.8 % considered as low, 1.7 % considered as very low and 1.4 % considered as no effect any more.

For providing water pump for flood prevention, 28.2 % of interviewed respondents considered this assistance as very important, while 29.9 % considered as high, 22.3 % considered as not high/not low, 3.8 % considered as low, 4.5 % considered as very low and 11.3 % considered as no effect any more.

For providing safety places for evacuation, 17.2 % of interviewed respondents considered this assistance as very important, while 22.4 % considered as high, 28.1 % considered as not high/not low, 8.1 % considered as low, 8.8 % considered as very low and 15.4 % considered as no effect any more.

For improving drainage system to increase flow of water, 47.3 % of interviewed respondents considered this assistance as very important, while 30.2 % considered as high, 18.5 % considered as not high/not low, 2.1 % considered as low, 1.1 % considered as very low and 0.8 % considered as no effect any more.

For providing relevant officers to take care of situation, 39.5 % of interviewed respondents considered this assistance as very important, while 33.4 % considered as high, 18.7 % considered as not high/not low, 3.8 % considered as low, 2.1 % considered as very low and 2.5 % considered as no effect any more.

Table 4.6 The Required Assistances Provided by Government

Required Assistances	Levels of required Assistances from Government						Total
	Very high	**High**	**Not high/not low**	**Low**	**Very low**	**No effect**	
1. provide updated information and accurate warning system	189 (31.5)	242 (40.3)	128 (21.4)	17 (2.8)	7 (1.1)	17 (2.9)	600 (100)
2. give instruction for flood preparation	134 (22.3)	245 (40.9)	178 (29.7)	19 (3.1)	11 (1.9)	13 (2.1)	600 (100)
3. provide sandbags for flood prevention	245 (40.8)	205 (34.2)	115 (19.1)	17 (2.8)	10 (1.7)	8 (1.4)	600 (100)
4. provide water pump for flood prevention	169 (28.2)	179 (29.9)	134 (22.3)	23 (3.8)	27 (4.5)	68 (11.3)	600 (100)
5. provide safety places for evacuation	103 (17.2)	134 (22.4)	169 (28.1)	48 (8.1)	53 (8.8)	93 (15.4)	600 (100)
6. improve drainage system to increase flow of water	284 (47.3)	181 (30.2)	111 (18.5)	13 (2.1)	6 (1.1)	5 (0.8)	600 (100)
7. provide relevant officers to take care of situation	237 (39.5)	200 (33.4)	112 (18.7)	23 (3.8)	13 (2.1)	15 (2.5)	600 (100)

4.1.4.2 The Important Flood Protection Measures included in Flood Control Project

By asking the respondents to prioritize with the scale of 1-6 regarding to the important flood protection measures appropriately included in flood control project, the results are as follows;

For cannel improvement measure, 27.6 % of interviewed respondents considered this measure as very important, while 36.9 % considered as high, 22.2 % considered as not high/not low, 4.8 % considered as low, 2.6 % considered as very low and 6.0% considered as no effect any more.

For drainage system improvement measure, 59.7 % of interviewed respondents considered this measure as very important, while 29.8 % considered as high, 6.3 % considered as not high/not low, 1.7 % considered as low, 0.9 % considered as very low and 1.7% considered as no effect any more.

For dam and reservoir construction measure, 22.4 % of interviewed respondents considered this measure as very important, while 33.2 % considered as high, 31.8 % considered as not high/not low, 6.5 % considered as low, 3.7 % considered as very low and 2.3% considered as no effect any more.

For floodplain zoning/regulation measure, 36.6 % of interviewed respondents considered this measure as very important, while 36.4 % considered as high, 19.3 % considered as not high/not low, 3.7 % considered as low, 1.1 % considered as very low and 2.8% considered as no effect any more.

For forest rehabilitation measure, 13.4 % of interviewed respondents considered this measure as very important, while 29.3 % considered as high, 33.2 % considered as not high/not low, 9.4 % considered as low, 4.0 % considered as very low and 10.7% considered as no effect any more.

For more water pump installment measure, 32.1 % of interviewed respondents considered this measure as very important, while 35.5 % considered as high, 27.0 % considered as not high/not low, 1.4 % considered as low, 0.9 % considered as very low and 3.1% considered as no effect any more.

For flood warning system improvement measure, 31.0 % of interviewed respondents considered this measure as very important, while 32.1 % considered as high, 25.3 % considered as not high/not low, 6.3 % considered as low, 0.9 % considered as very low and 4.5% considered as no effect any more.

Table 4.7 The Important Flood Protection Measures

Required Measures	Levels of required Flood Protection Measures						Total
	Very high	High	Not high/not low	Low	Very low	No effect	
1. cannel improvement	166 (27.6)	221 (36.9)	133 (22.2)	29 (4.8)	16 (2.6)	35 (6.0)	600 (100)
2. drainage system improvement	358 (59.7)	179 (29.8)	38 (6.3)	10 (1.7)	5 (0.9)	10 (1.7)	600 (100)
3. dam and reservoir construction	220 (36.6)	218 (36.4)	116 (19.3)	22 (3.7)	7 (1.1)	17 (2.8)	600 (100)
4. floodplain zoning / regulation	134 (22.4)	199 (33.2)	191 (31.8)	39 (6.5)	22 (3.7)	15 (2.3)	600 (100)
5. forest rehabilitation	80 (13.4)	176 (29.3)	199 (33.2)	56 (9.4)	24 (4.0)	65 (10.7)	600 (100)
6. more water pump installment	193 (32.1)	213 (35.5)	162 (27.0)	8 (1.4)	5 (0.9)	19 (3.1)	600 (100)
7. flood warning system improvement	186 (31.0)	193 (32.1)	152 (25.3)	38 (6.3)	5 (0.9)	26 (4.5)	600 (100)

4.2 The Public Demand for a Flood Prevention Scheme

From our 600 sample with contingent valuation method (CVM) survey with five different rates of income tax payments, the result (Table 4.8) showed the number and percentage of respondents who were willing and able to support our flood tax program. As for figure in table 4.8, the public demand for flood tax scheme had been diminishing from at least 90% of respondents at the tax payment of THB 500 to 23% at tax payment of THB 2,500. This demand obviously declined with respect to an increase on tax payment.

As seen in the table below, the total number of respondents who were willing and able to support our flood tax was 329 respondents which accounted for approximately 55% of total respondents. Therefore, there were about 45% of respondents who were not willing and not able to support flood tax. The two main reasons obtained from questionnaire why they were not willing to pay for flood tax were first accounting for 58%, they had no money to support this flood prevention program and second accounting for 32%, they do not think that this program is effective to prevent flood in our society accordingly. The other reasons accounting for 10% were, they do not see the benefit of the program, they do not think their living place will get affected with flooding and other reasons respectively.

Table 4.8 Number of Respondents Willing and Able to Support Our Flood Prevention Scheme, by the Rate of Tax Payment

Rate (baht)	**Response "Yes"**
500	105 (87.5%)
1000	83 (69.17%)
1500	70 (58.33%)
2000	43 (35.83%)
2500	28 (23.33%)

Note: Total Number of respondent per rate of tax payment equals to 120 persons.

As regards the demand analysis, our study had divided it into two sectors: (a) the estimation of the log-linear probit model and defensive expenditure method by using ordinary least square model (OLS) and Tobit model and (b) the estimation of mean willingness to pay (WTP) for flood prevention scheme including the calculation of mean willingness to pay for defensive expenditure for the propose of household flood prevention and the comparison between both of them for consistency and compatibility. Our analysis of the demand for flood tax scheme is as follow.

4.2.1 The Estimation of the Log-Linear Probit Model

Before we estimated this model with maximum likelihood method, we had detected the outlying observations or outliers and influential observations in our model and then replaced them with their means because the outliers resulted in the rise of heteroscedasticity problem (Gujarati, 2003).

With the Lagrange Multiplier (LM) test under the binary response model regression (BRMR), the demand models have been exempted from the heteroscedasticity problem. Due to the large numbers of observation in the model, our demand model under the central limit theorem assumed that it has statistically held the properties of normal distribution (Gujarati, 2003) because this is the bottom line of using a probit model. To guard against the misspecification problem, our study also estimated probit model with "robust variance estimators", or Huber White, or sandwich standard errors. These estimates are considered robust in the sense that they provide correct standard errors and also the best possible approximation to the true probability density function (Greene, 2008).

4.2.1.1 The Full Demand Model for a Flood Prevention Scheme

Research question 1: What are the key factors influencing an Individual's payment for this flood prevention scheme?

As shown in Table 4.9, the results present both full and fitted models. The full model depicts all explanatory variables included in the model, while the fitted model, nested in full model, has better goodness-of-fit because it has the lower Akaike's and Bayesian information criterions (AIC and BIC). Also the fitted model is statistically preferred to the full model because the difference in BIC between two of them is significantly positive (Rafteery, 1995).

Although the pseudo R2 in full model is slightly higher than the fitted model, this measurement, R2, is not particularly meaningful in probit model (Gujarati, 2003). Like F test in the linear regression, the likelihood ratio (LR) statistic test has significantly confirmed with the zero P-value that these two models have rejected the null hypothesis of that all the slope coefficients are simultaneously equal to zero.

Regarding the dependent variables the demand of willingness to pay for flood prevention scheme (WTP), these findings also depict the probit estimates of all the coefficients (using maximum likelihood methods) as well as estimate of the marginal effects relating to the probability of willingness to pay change when you change one (X) explanatory variable on the model, holding the other explanatory variables constant.

With the robust variance estimators in this probit model (see fitted model), only RATE, SEX, MARITAL, OCCUPATION INCOME, TYPE EXPECTED AREA, RISK, and EXPENSE all are statistically significant at 5% significant level. INCOME and AREA both tangibly play the major factor on the willingness to pay for flood prevention scheme for policy recommendation.

Table 4.9 Determinants of WTP for the Demand Model

Model 1 : Probit model of the demand for flood prevention program					
Variable	**Full model**		**Fitted model**		
Independent Variable	**Coefficient**	**P-value**	**Coefficient**	**Marginal effect**	**P-value**
Constant	-56.913	0.000	-37.386		0.000
Rate *	-0.0043	0.000	-0.004	-0.001	0.000
Sex*	1.470	0.026	1.349	0.425	0.014
Age	-0.122	0.252			
Marital*	-2.052	0.043	-1.736	-0.561	0.005
Education	-1.137	0.322			
Occupation*	2.467	0.009	1.759	0.381	0.010
Family	-0.003	0.994			
Child	0.493	0.389			
logIncome*	5.919	0.001	3.515	0.328	0.000
Owner	-0.377	0.679			
Type*	-2.752	0.019	-1.806	-0.404	0.013
Flood Sensitive	1.335	0.156			

Table 4.9 (Continued)

Model 1 : Probit model of the demand for flood prevention program					
Variable	**Full model**		**Fitted model**		
Independent Variable	**Coefficient**	**P-value**	**Coefficient**	**Marginal effect**	**P-value**
Expected*	3.732	0.001	3.390	0.900	0.001
River	1.577	0.077			
Area*	2.836	0.009	2.439	0.648	0.007
Risk*	2.272	0.000	2.095	0.681	0.000
Exp	0.464	0.560			
logExpense*	0.439	0.003	0.323	0.105	0.004

Summary Statistics	Full model	Fitted model
Number of obs	600	600
Log-likelihood	-13.883	-16.615
LR	792.77	787.31
Prob> LR	0.000	0.000
Pseudo R square	0.9662	0.9595
BIC	149.3077	116.3891
AIC	65.76605	59.22904

As ceteris paribus, people with higher income are willing to financially support our scheme with the one – third possibility. Moreover, the individual, in contrast, is not going to pay for this scheme if the rate of tax payment has been marginally increased.

Regarding the table 4.9, SEX, OCCUPATION, EXPECTED, RISK, AREA and EXPENSE have the same sign coefficients as positive whereas the coefficient on MARITAL and, TYPE are obviously negative.

With a 5 % possibility, for SEX if an individual who were male, he is more likely to sponsor this flood prevention scheme than would a female. For OCCUPATION, those who have worked in public companies such as governmental officers are more likely to be flood sensitive, hence more willingness to pay more for flood prevention scheme.

Likewise, EXPECTED those who have not planned to sell their property within 5 years are more likely to pay for this flood prevention scheme. Then as for RISK, if respondents have perceived the high level of flood risk on their property, they are more willing to pay for this scheme. For EXPENSE, such that respondents with higher expense for flood prevention in 2011 are more likely to support this flood prevention scheme. Additionally, for AREA, those whose living properties are situated in the low-lying area are more likely to pay for flood prevention scheme because they may have perceived that they have been more likely to suffer from flooding comparing with those respondents living in high level areas.

Other things being equal, MARITAL and TYPE showed a negative relationship to the demand for the willingness to sponsor this scheme such that those respondents who have married are more likely to pay less for this program. Moreover, for TYPE, those whose living properties constitute more than first floor, they are more likely to pay less for flood prevention program comparing with those whose properties constitute only first floor. It may be because when the flooding will come, those respondents whose living properties constitute more than first floor will have a higher chance to evacuate to the higher floor of their living properties.

Table 4.10 Income Elasticity of the Full Demand

	Elasticity	**P-value**
Income (Logarithm form)	3.082	0.00

Consistent with Table 4.10, it also confirmed that 1% increase in income will lead approximately a 3% rise in demand for flood prevention scheme.

Then, we substituted variable AREA with real dummy geographic variables in term of average height in each particular area, AREA 1, AREA 2, AREA 3 and AREA 4 in such a way that AREA 1 represents living properties of respondents situated in area of 1.5-2.5 meters average height for example, in this survey, in Chom Thong and Thung Khru districts, AREA 2 represents living properties of respondents situated in area of 1-2 meters average height such as in Thawi Watthana district, AREA 3 represents living properties of respondents situated in area of 0.5-1 meters average height such as in Phasi Charoen and Bang Khae districts, and AREA 4 represents living properties of respondents situated in area of 0-0.5 meters average height such as in Nong Khaem district in order to find ,in more detail, the relationship between the height of the living area and the willingness to pay for flood prevention scheme. The information in term of average height in each particular area to be used in this estimation would be obtained from specialist in flooding from the academic institute already published via media at the time of flood event in 2011. The result was as follow in the table 4.11;

Table 4.11 Substitution of AREA Variable with AREA 1 AREA 2 AREA 3 and AREA4 Variables

Model 2 : Probit model of the demand for flood prevention program with substitution of AREA variable with AREA 2 AREA 3 and AREA4 variables					
Variable	**Full model**		**Fitted model**		
Independent Variable	**Coefficient**	**P-value**	**Coefficient**	**Marginal effect**	**P-value**
Area2*	2.584	0.003	2.498	0.416	0.002
Area3*	2.812	0.010	2.536	0.479	0.015
Area4*	3.679	0.009	2.902	0.712	0.007

As seen above, those who have lived in the geographically lowest area of this survey especially in the 0-0.5 meters average height area are more likely to pay more for flooding prevention scheme comparing with those who have lived in the geographically highest area in the 1.5-2.5 meters average height. Likewise, those who have lived in the geographically lower area in the 1-2 and 0.5-1 meters average height area are more likely to pay more for flooding prevention scheme comparing with those who have lived in the geographically highest area in the 1.5-2.5 averages height respectively.

In comparison with the defensive expenditure approach by using the ordinary least square method (OLS) and also the tobit model in which the dependent variable to be used in the model is the amount of household expenditure in term of Baht spent for flood prevention in 2011, while the independent variables to be used in this model are almost the same as those already used in the probit model. The reason why we use the Tobit model in this paper was that it was better to discard the respondents who have not spent money on flooding protection, while allowing all respondents to stay in the sample to prevent sample selection problem.

Table 4.12 Model of the Defensive Expenditure for Flood Prevention Program

Model 3 : model of the defensive expenditure for flood prevention program								
Model	**OLS**				**Tobit**			
Independent Variable	**Full model**	**P-value**	**Fitted Model**	**P-value**	**Full model**	**P-value**	**Fitted Model**	**P-value**
Constant*	-668.494	0.081	-319.074	0.046	-670.688	0.136	-393.938	0.014
Sex	-19.441	0.818			-21.354	0.795		
Age	15.107	0.272			-6.454	0.699		
Marital	-42.583	0.776			-40.344	0.796		
Education	130.96	0.321			133.464	0.326		
Occupation	-110.0047	0.319			-107.648	0.311		
Family*	-293.0706	0.000	-257.249	0.000	-291.053	0.0001	-316.752	0.000
Child*	-172.188	0.086	-191.737	0.004	-169.079	0.084	-167.598	0.002
Income*	0.0058	0.105	0.00904	0.004	0.0201	0.006	0.00798	0.0015
Owner*	481.021	0.001	588.261	0.000	482.252	0.0003	593.500	0.000
Type*	-728.918	0.000	-764.242	0.000	-733.176	0.000	-786.818	0.000
Flood Sensitive	113.907	0.322			116.168	0.270		
Expected	48.986	0.670			49.085	0.689		
River*	292.391	0.038	315.437	0.021	296.315	0.0246	341.340	0.0032
Area*	632.17	0.001	608.358	0.001	637.019	0.0007	642.429	0.0001
Risk*	350.26	0.000	334.032	0.000	363.445	0.0000	344.258	0.000
Exp	-61.717	0.719			-57.398	0.746		
Sex	-19.441	0.818			-21.354	0.795		

Table 4.12 (Continued)

Model 3 : model of the defensive expenditure for flood prevention program								
Model	**OLS**				**Tobit**			
Independent Variable	**Full model**	**P-value**	**Fitted Model**	**P-value**	**Full model**	**P-value**	**Fitted Model**	**P-value**
Summary of Statistics			OLS		Summary of statistics			Tobit
R2			0.60		AIC			10.718
Pseudo R2			0.59		Schawarz criterion			10.792
F Stat			54.87		Hannan-Quinn criter			10.747
Prob(F Stat)			0.00		Log likelihood			-3205.635
Durbin-Watson			1.88					

With the estimation by using both OLS model without autocorrelation and heteroscedasticity problems and Tobit model only FAMILY, CHILD, INCOME, OWNER, TYPE, RIVER, AREA and RISK all are statistically significant at 5% significant level.

Regarding the table 4.12, INCOME, OWNER, RIVER, AREA and RISK have the same sign coefficients as positive whereas the coefficient on FAMILY and CHILD are obviously negative. With a 5 % possibility, for INCOME, people with higher income are more willing to financially pay for their own flood prevention. Moreover, for OWNER, if an individual were the owner of properties, he is more likely to put more effort in term of expenditure for flood prevention. Likewise, for geographical characteristics such as RIVER and AREA, those who have lived in the low lying areas or very close to the main river, they are more likely to pay expense for their own flood prevention. In addition, for RISK, those who have more flood risk where they have lived in the flood prone areas or other relating flood risk, they are more likely to pay expense for their own flood prevention.

Other things being equal, FAMILY, TYPE and CHILD showed a negative relationship to the amount of expenditure for household flood prevention. Those respondents who have a number of family members including child are more likely to pay less for flood prevention expenditure. It may be because of their budget constraint such that they have not had extra-money spent for flood prevention expenditure. Then as for TYPE, if respondents have lived only in the first floor which has been to be directly and seriously affected by flooding, they are more willing to pay for their own flood prevention.

4.2.1.2 The Estimation of Mean Willingness to Pay (WTP)

Regarding our contingent valuation method (CVM) survey, it was based on single bounded format to estimate the public demand for a flood prevention scheme. This method has been discussed on section 3.1.3 in Chapter 3.

Table 4.13 Distribution of Responses by Various Initial Rate of Tax Payment in Single Bounded Format

Rate (Baht)	**Yes (n %)**	**No (n %)**
Initial rate = 500 baht	105(87.5%)	15(12.5%)
Initial rate = 1000 baht	83(69.17%)	37(30.83%)
Initial rate = 1500 baht	70(58.33%)	50(41.67%)
Initial rate = 2000 baht	43(35.83%)	77(64.17%)
Initial rate = 2500 baht	28(23.33%)	92(76.67%)

Note: n = number of respondents; % = percentage of respondent willing and able to pay for our flood prevention scheme with different rate of tax payment (in term of baht); and total number of respondent per rate of tax payment equals 120 persons

Research question 2: How much would individual be willing to pay for the flood tax by using contingent valuation and preventive expenditure approach?

Our study estimated mean WTP for flood tax from singles bounded format by using probit model and estimated WTP for flood expenditure from defensive expenditure approach by using tobit model including $\hat{Y}$ in OLS model. The results were as follows:

Table 4.14 The Mean WTP Calculated from Probit Model with Respect to Different Geographical Aspects Comparing with Mean WTP from Tobit Model and $\hat{Y}$ from OLS

Model	Mean WTP or $\hat{Y}$ at 5% significant level	baht
Probit	1.Mean WTP for flood prevention with low-lying area	1,878.21
	Mean WTP for flood prevention with high -lying area	1464.28
Probit	2.Mean WTP for flood prevention with close-river area	1,864.00
	Mean WTP for flood prevention with far away- river area	1,679.16
OLS	$\hat{Y}$ for flood prevention expenditure	1,457.98
Tobit	Mean WTP for flood prevention expenditure	1,286

As for various type of Mean WTP (See Table 4.14), our study has to verify those values have statistical difference in the aspects of geographic characteristics: AREA (respondents who have lived in low-lying and high-lying area) and RIVER (respondents who have lived close and far away from main river) by estimating the probit model including those features as the dummy variables.

The results from our contingent valuation study showed that there was a potential-demand for a flood prevention and maintenance program with the mean willingness to pay (WTP). The mean WTP values for flood prevention scheme with those who have lived in low-lying area was 1,878 baht using single bounded method in probit model, while for those who have lived in high area had a mean WTP of 1,464 baht., In comparison with the mean WTP for defensive expenditure by using tobit model and the mean defensive expenditure ($\hat{Y}$) calculated from OLS model were 1,286 baht 1,458 baht respectively. Comparing with these three models, those figures were very close reflecting the consistency and accountability of mean WTP values for flood prevention scheme by using contingent valuation method.

Table 4.15 Probit Results for Differing Type of Mean WTP

Model : Probit of the full demand for a flood prevention program			
Independent variable	**Coefficient**	**Marginal effect**	**P-value**
Constant	-10.914		0.000
Income (Logarithm form)	1.001	0.391	0.000
Rate	-0.0025	-0.0012	0.000
AREA	-0.806	-0.304	0.002
RIVER	1.172	0.426	0.312
Summary Statistics			
Number of obs	600		
Log-likelihood	-174.507		
LR	471.52		
Prob> LR	0.000		
Pseudo R square	0.5746		
BIC	380.9999		
AIC	359.0153		

With the method of maximum likelihood estimation, the results of the probit model were presented in Table 4.15 with respect to various geographical aspects of mean WTP as the dummy variables which were AREA and RIVER accordingly.

As regards the likelihood ratio (LR) test, it showed that all coefficients in explanatory variables are not equal to zero at any reasonable significance level. INCOME RATE and AREA are thus statistically significant, while RIVER representing the feature of mean WTP is statistically insignificant at any significance level. As expected, the mean WTP for those who have lived in the low-lying area should be higher than for those who have lived in high area because those lived in low area would be more likely to benefit from our flood prevention scheme.

As seen from the results, the two important factors that influence the willingness to pay (WTP) for flood tax are income and height of the area respectively. From this study, in order to obtain more specified willingness to pay for flood tax, we estimated WTP based on each particular income/month as categorized in five levels which are 20,000 40,000 60,000 80,000 and 100,000 baht/month and each different height level of the areas determined as either low-lying area (0-1 meter height) or high-elevated area (1-2.5 meter height). The results are as follow.

Table 4.16 Different Willingness to Pay (WTP) for Flood Tax Categorized by Income/Month Level and Height of the Area

Income (Baht/month)	**Low-lying Area (0 – 1 meter height) /(% increase)**	**High-elevated Area (1 – 2.5 meter height) /(% increase)**
20,000 baht/month	1,784 baht / (- %)	1,420 baht/ (- %)
40,000 baht/month	1,953 baht / (9.5%)	1,548 baht / (9.0%)
60,000 baht/month	2,125 baht / (8.8%)	1,680 baht / (8.5%)
80,000 baht/month	2,280 baht / (7.3%)	1,798 baht / (7.0%)
100,000 baht/month	2,420 baht / (6.1%)	1,902 baht / (5.8%)

From the estimated results of different willingness to pay for flood tax with five different incomes per month levels and two different area heights, the result (Table 4.16) showed the willingness to pay for flood tax who resided in low-lying area with incomes of 20,000 40,000 60,000 80,000 and 100,000 baht/month were 1,784 1,953 2,125 2,280 and 2,420 bath respectively. In addition, the willingness to pay for flood tax who resided in high-elevated area with incomes of 20,000 40,000 60,000 80,000 and 100,000 baht/month were 1,420 1,548 1,680 1,798 and 1,902 baht accordingly. As reflected by the results which are consistent with the reviewed theory, it can be seen that, comparing with the same income per month level, those who have resided in low-lying area are more likely to pay for flood tax than those who have lived in high-elevated area. Moreover, comparing with those who have resided in the same area height, respondents who have earned more income are more likely to pay for flood tax than those who have earned less income. In addition, the amount of willingness to pay for flood tax of respondents will increase as their income increase at diminishing rate.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 The Public Demand for a Flood Protection Scheme

The purpose of this study was to obtain in-depth information from the public, the general population who have lived and worked in Bangkok where directly benefits from flood control project including both males and females, about the degree of financial support for this flood prevention and maintenance scheme. Also the study, by the use of CVM, was to analyze how much each person would be willing to pay for this program with yearly income tax payment and what were the key factors influencing them to finance this scheme in accordance with their behaviors especially, geographical characteristic in order for government to appropriately design flood tax with equity and efficiency manner.

As a result of this study, we found that level of income importantly affected the willingness to pay of respondents in case that government will initiate to start the flood control project. Therefore, in case government decided to start collecting revenue in form of flood tax, ability to pay of people should be taken into account and especially the government should give the assistance or waived the flood tax particularly for low income people in order to access in this necessary service for equity manner.

In case that there was any operation or project to be considered as a public good, for example in this study the flood control project, in the initial state there was a problem or obstacle in collecting revenue in form of tax or any either forms because of some people' unwillingness to pay. Therefore, the necessary information obtained from the study especially for example necessary assistances requested from the government in case of flooding and important flood protection measures included in flood control project which already were included in our survey could help the government to design the flood control project that perfectly reflected people' desire and need. Moreover the calculated WTP obtained from this study was very useful for government to execute a plan and could be used as a databaseorreference in designing flood tax collection for effective flood control project implementation with least people's resistance in term of willingness to pay.

The results from our contingent valuation study showed that there was a potential-demand for a flood prevention and maintenance program with the mean willingness to pay (WTP). The mean WTP values for flood prevention scheme with those who have lived in low-lying area was 1,878 baht using single bounded method in probit model, while for those who have lived in high area had a mean WTP of 1,464 baht. In comparison with the mean WTP for defensive expenditure by using tobit model and the mean defensive expenditure ($\hat{Y}$) calculated from OLS model were 1,286 baht 1,458 bahtrespectively. Comparing with these three models, those figures were very close reflecting the consistency and accountability of mean WTP values for flood prevention scheme by using contingent valuation method.

Our study also attempted to investigate the determining factors in the public demand for this flood prevention program. Using the estimation of maximum likelihood method, the results of our probit model showed many factors influencing individuals to make their decisions whether they were willing to sponsor our flood prevention scheme. First, both income and rate of tax payment were the most dominant factors. Income had a strong positive impact on the demand for this scheme. As expected, people witha higher income were more likely to pay their income taxes to support this scheme. With a high possibility of 0.3, people on higher income tended to be willing to finance this program, other things being equal. On the other hand, the rate of tax payment for supporting this scheme had a negative effect on willingness to pay.

In line with INCOME and RATE, geographic characteristics factor which only was AREA also influenced respondents to willingly pay for this flood prevention scheme in which those who have lived in the low lying areas were more likely to pay expense for flood prevention scheme.

Apart from relevant factors influencing and WTP for supporting this program, this survey also asked the respondents about the necessary assistances requested from the government in case of flooding and the important flood protection measures included in flood control project.

For necessary assistances requested from the government in case of flooding, the first three assistances from government to be considered as very important for the surveyed respondents were improving drainage system to increase flow of water, providing sandbags for flood prevention andproviding relevant officers to take care of this situation respectively.

For important flood protection measures included in flood control project, the first three important measures considered as very important for the surveyed respondents were drainage system improvement, dam and reservoir construction and more water pump installment respectively.

5.2 Methodological Issues

Subsequent to our study, there were many interesting methodological issues we would like to discuss and suggest for future studies because we were confronted with these problems which we had been limited in solving. Firstly, our CVM study used the single bounded format. If they indicated the answer to that question was no, they were asked if they would be willing to provide an explanation as to why they would not support the proposal. These responses were used to classify protest bids. If the zero WTP was proved to be biased, their answers on WTP would then be deleted and considered as a ‘non-response’. From empirical study (Pinucia, 1988), differences of efficiency between single bound and double bound method tend to reduce by increasing the sample size, and are often negligible for medium size samples. On the contrary no relevant differences can be found in point estimates of parameters and central tendency measures between the two models, even for small sample size, and no estimator can be said to be less biased than the other. Therefore, the use of single bound model whenever the sample size is large enough, and the pre-test conducted on a small population sample is thought to give a good priori for the bid design of the survey. If instead the sample size is very small, or the pre-test survey is not much reliable, it is advisable to use the double bound model.

Secondly, as for content validity, our study tried to guard against the scenario misspecification bias which occurs when a respondent does not respond to the correct valuation scenario. In other words the respondent does not understand the scenario as our study intended it to be understood. This can be avoided by the use of focus groups, pilot surveys, and pretests. On the top of this, our study initially used “the storyboard” to help explain our contingent valuation scenario. The storyboard was immediately comprehensible to respondents while they were listening to our scenario explanation which may be obscure if the respondent was not familiar with flood protection scheme or the tax payment issue. At the same time, this storyboard would ensure that the explanation of the scenario given by our enumerators was consistent and accurate. This storyboard also helped our enumerators to convey complex ideas or bodies of information in our scenario while they had in-person interviews. Our study meanwhile applied “cheap talk script” to encourage the respondents to tell the truth before they started to elicit their WTP amounts. This mechanism was designed to solve hypothetical bias due to the hypothetical nature of the payment commitment (Bateman et al., 2002).

Thirdly, as for hypothetical scenario in this study, it is assumed that the flood control project implemented by government will reduce the probability of floodoccurrence for 95% to be used in the survey for eliciting willingness to pay for flood tax. The percentage of reduced probability of flooding will reflect the trust of government of how government will manage flood effectively, therefore, future study by asking respondents with variety percentages of probability of reduced flood occurrence to obtain many willingness to pay for flood tax in order to reflect the degree of trust of government will be meaningful for designing flood tax collection which is not done in this study.

Fourthly, the probit model is generally estimated with the maximum likelihood (ML) method; however the study by Arana and Leon (2002) found that the results of a probit model analyzed by the Bayesian estimation method led to better results compared to the maximum likelihood methods. According to the goodness of fit measure, this Bayesian method showed more accurate estimation of the parameters with small samples. So our study would strongly recommend this Bayesian method for next future CVM study because it performed better than ML method for conducting inference with the small samples. With the limit of the CVM method on this study, we would recommend future research to obtain a detailed analysis of our flood prevention program by using the choice experiment (CE) approach. On the evidence of many stated preference studies by Bateman et al. (2002), there are some advantages in using the choice experiment technique. First, the CE method does better job than the CVM study in terms of measuring the marginal value of changes in the characteristics of goods. This is often a more useful focus from a management or policy perspective than focusing on either the gain or loss of the good, provided by CVM study. Second the CE method can reduce the extreme multi-collinearity problems in models based on variations in actual attribute values. Last, the CE approach may avoid some of the response difficulties in CVM study. Dichotomous choice designs in the CVM study, for instance might still be the subject to yes-saying despite improvements in design standards. Also the open-ended CVM format avoids the yes-saying problem, but is viewed as facing respondents with a mental task, which may be difficult. Then it leads to item non-response or random responses. Despite this the CE approach faces respondent with much easier problem with the question of whether the respondent prefers, A, B or neither.

Fifthly, in order to investigate in more detail about geographic characteristics in term of both the height of the area and the distance to the main river, executing GPS data matching with the surveyed areas of each particular respondent rather than using the average height data of each district or perceived variable would help researcher to get more reliable and exact results and finally come into more efficient and better policy recommendation.Moreover, as mentioned earlier, flood tax implementation can create loss-incentive reducing behaviors which make people tradeoff between high flood tax payment by staying within the flood risk area and movement to the flood resistant area in exchange for paying lower tax rate. However, in this study, it does not ask the respondents the minimum value at mean of flood tax rate in the flood prone area that can stimulate them to move on to the flood resistant area which is the interesting topic to be further researched in the future.

Lastly, this study is mainly based on the CVM methodology with the partly use of OLS method for comparing the results. However, there is also other useful methodologiesto be used such as Hedonic Pricing Method to explicitly calculate either themarketable decrement value of land price where it is frequency flooded or the marketable increment value of land price where it is hardly flooded especially the flood disaster in 2011 which is beyond the scope of this study.

5.3 Policy Implication of Results and Suggestions

The study based on the CVM results would suggest some policy implications if the flood prevention scheme already existed. First, it strongly recommends to our policy makers to provide a flood protection scheme because it benefits people by reducing flood impactin terms of life, social and economic impacts which resulted in human casualties, damage to properties, and disruption of economic activities in the affected area.

Table 5.1 Income Tax Payment for Supporting the Flood Prevention Scheme 1

"Annual personal income for person aged 20-60 (Baht: before tax)"	**Yearly tax payment (Baht)**	
	0 - 1 m area height	**1-2.5 m area height**
Less than 240,000	0	0
240,000	1,900	1,500
More than 240,000	"more than 1,900 with an addition on 3% progressive income	more than 1,500 with an addition on 3% progressive income

Second, this publicly funded program should initially be implemented for yearly basis based on respondents' preference.The government could raise money to subsidize this program by using a progressive income tax with differentiated geographical living place areas for the purpose of equity and efficiency manner.Apart from survey of respondents' preference about flood tax base, the reasons why this study recommends flood tax based on income tax is that it is easy to implement and still exist in Thailand. In addition, it is actually applied in many countries such as Australia, Pakistan and Germany in reality. With the positive influence of the individual’s income on the amount of willingness to pay, this progressive tax would charge a higher percentage of the individual’s income as their income rises with respect to sponsoring this program. Payment for supporting this scheme should be also based on the height of the area with the positive influence of the individual’s living place areas on the amount of willingness to pay in such a way that payment would be willingly paid higher for low living place areas with respect to sponsoring this program. Regarding Table 5.1, it shows the yearly income tax payment based on annual personal income and the height of the area for supporting this program. To finance this scheme, Thai taxpayers aged 20-60 years with different income and living place areas in term of height are obliged to pay a yearly differentiated income tax payment. The payment nonetheless is based on annual personal income and the area they are living. For example, if anyone has annual income (before tax) less than 240,000 baht (240,000 baht is approximately total income per year before other individual expense deductible that legally has not yet been taxed) no matter where they have lived, they would be given an exemption from paying it. On the other hand any individual whose yearly income is in excess of 240,000 baht and they are living in the low-height area (0-1 m area height) is required to pay “yearly” tax payment as the base of 1,900 baht. Any individual whose yearly income is in excess of 240,000 baht and they are living in the high-height area (1-2.5 m area height) is required to pay “yearly” tax payment as the base of 1,500 baht. In addition to this base payment of 1,900 and 1,500 baht based on different living place areas, an extra payment based on a 3% (3% is income elasticity)tax on annual income of in excess of 240,000 bahthas been collected. Someone, for example, with his annual income as 250,000 baht living in the low-height area has an obligation to pay 1,900 baht plus an additional 300 which has been calculated from 3% of 10,000 baht which was earned in the excess of the 240,000 baht base.

Another policy recommendation to be suggested, instead of charging additional certain percentage on individual income, it is recommended to implement either individual income level or income range level as reference for flood tax collection. The designed income or income range level should be determined as appropriate by the government for the purpose of collecting flood tax with equity and efficiency manner as illustrated as an example in the table 5.2 below.

Table 5.2 Income Tax Payment for Supporting the Flood Prevention Scheme 2

"Monthly personal income level for person aged 20-60 (Baht)"	Yearly tax payment (Baht)	
	0 - 1 m area height	1-2.5 m area height
20,000	1,800	1,400
40,000	1,950	1,550
60,000	2,100	1,700
80,000	2,300	1,800
100,000	2,400	1,900

As seen from the table above, in this example, flood tax should be collected based on people income and area height by dividing income into five different levels and area height into two levels. The flood tax in this scheme will be calculated directly from the willingness to pay of respondent taking into account the real their income and area height level in order to obtain the true willingness to pay reflected in form of flood tax. The advantage of this flood tax scheme is that the government could collect flood tax based on their true willingness to pay accounting for both their real income and area height level. However, the disadvantage of this flood tax scheme is the complexity of having many level of people incomefor flood tax collection.

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APPENDICES

APPENDIX A

Probit Model

Kmenta, Jan described the Probit model that:

As alternative S-shaped curve that satisfies the requirements of a probability model is the cumulative normal distribution function corresponding to the so-called probit model. This model is usually derived as follows. Let us consider an unobservable variable Y_i^* given as

$$Y_i^* = \alpha + \beta X_i + \varepsilon_i$$

Where $\varepsilon_i \sim N(0,1)$ and ε_i and ε_j ($i \neq j$) are independent. The observable binary variable Y_i is related to Y_i^* in the following way.

$$Y_i = 1 \text{ if } Y_i^* > 0$$
$$= 0 \; Y_i^* \leq 0$$

Then

$$E(Y_i) = \pi_i = P(Y_i = 1)$$
$$= P(Y_i^* > 0) = P(-\varepsilon_i < \alpha + \beta X_i)$$
$$= F(\alpha + \beta X_i), \qquad (1)$$

where F(.) represents the cumulative distribution function of the standard normal distribution. That is

$$F(\alpha + \beta X_i) = \int_{-\infty}^{\alpha+\beta X_i} f(z)\, dz$$

where f(z) represents the density function of $z \sim N(0,1)$. Since $\pi i = F(\alpha + \beta Xi)$, we can write

$$F\text{-}1(\pi i) = \alpha + \beta Xi \qquad (2)$$

where F-1(πi) is the inverse of the standard normal cumulative distribution function.

The parameter α and β in (2) can be estimated by the maximum likelihood method using the log-likelihood function, L=∑_(i=1)^n▒[Y_i log⁡〖π_i 〗 +(1-Y_i) log⁡(1-π_i)] Substituting for π_i from (1) into log-likelihood function, we therefore obtain

$$L = \sum \{Y_i \log F(\alpha + \beta X_i) + (1 - Y_i) log[1 - F(\alpha + \beta X\_i\ )]\}$$

Maximizing L with respect to α and β and estimating the standard errors with the help of the information matrix is complicated, but computer programs for this purpose are readily available. When we have replicated observations on Y for each different value of X, the problem of estimation becomes simpler. Let p_i be defined as in

$$p_i = \frac{1}{n_i} \sum_{j=1}^{n_i} Y_{ij}$$

Then we can write

$$F_{-1}(p_i) = F_{-1}(\pi_i + \varepsilon_i)$$

And, using the Taylor expansion around $\pi_{i,}$ obtain

$$F^{-1}(p_i) = F^{-1}(\pi_i) + \frac{\partial F^{-1}(\pi_i)}{\partial \pi_i} \varepsilon_i + R_i$$

where R_i represents terms of order higher than one, which can be dropped because they become very small when n_i is larger. Further,

$$\frac{\partial F^{-1}(\pi_{-1})}{\partial \pi_i} = \frac{\partial(\alpha+\beta X_i)}{\partial F(\alpha+\beta X_i)}$$

$$= \frac{1}{\partial F(\alpha + \beta X_i) / \partial(\alpha + \beta X_i)}$$

$$= \frac{1}{f(\alpha+\beta X_i)}$$

where $f(\alpha + \beta X_i)$ is a standard normal density function evaluated at $\alpha + \beta X_i$.

Therefore, we obtain the following large-sample relation.

$$F_{-1}(p_i) = \alpha + \beta X_i + \frac{\varepsilon}{f(\alpha+\beta X_i)}$$

Note that

$$E\left[\frac{\varepsilon_i}{f(\alpha+\beta X_i)}\right] = 0$$

$$Var\left[\frac{\varepsilon_i}{f(\alpha+\beta X_i)}\right] = Var\left[\frac{p_i}{f(\alpha+\beta X_i)}\right]$$

$$= \frac{\pi_i(1-\pi_i)}{n_i[f(\alpha+\beta X_i)]^2}$$

The latter can be estimated consistently by replacing π_i by p_i and α and β by $\hat{\alpha}$ and $\hat{\beta}$, where $\hat{\alpha}$ and $\hat{\beta}$ are the ordinary least squares estimator of α and β in (4).

After obtaining a consistent estimate of the variance of $\varepsilon_i / f(\alpha + \beta X_i)$, we can obtain least squares estimates corrected for heteroskedasticity. Both estimators- maximum likelihood and least squares estimates corrected for heteroskedasticity are asymptotically normal and have all the desirable asymptotic properties.

The Difference between the Logit and Probit Models

When dealing with binary dependent variables, a question usually arises as to which of the two nonlinear models either logit or probit model to choose. Kmenta (1986) stressed that the best answer to that question would be based on theoretical grounds, but well-developed theory to determine the exact functional form appears to be lacking. Many authors, nonetheless, tend to agree on the following points:

a) The logistic and cumulative normal functions are very close in the midrange, but the logistic function (logit model) has slightly heavier tails than the cumulative normal (probit model). Thus it does not matter much which function is used to expect in case where the data are heavily concentrated in the tails.

b) The logit model is used because it represents a close approximation to the probit model and is simpler to work with. The close similarly between the logit and probit models is confined to dichotomous dependent variables. When the dependent variable is polytomous , there are major differences between both of them. However, researchers are interested in having a scalar measure of the "goodness of fit" of their model. In this standard regression model this role is taken by R^2 or R^{-2}, in the context of the logit and probit model a similar measure, called the "Likelihood ratio index

(LRI)", is given by $LRI = 1 - \frac{L(\widehat{\Omega})}{L(\widehat{\omega})}$ where $L(\widehat{\Omega})$ is the maximum value of the log-likelihood function, and $L(\widehat{\omega})$ is the maximum value of this function under the constraint that β = 0. Evidently, $0 \leq LRI \leq 1$ and the better the fit, the closer the value of LRI will be to one. The quantities $L(\widehat{\Omega})$ and $L(\widehat{\omega})$ can also be used to carry out a likelihood ratio test of the null hypothesis that X is irrelevant in the determination of E(Y). The test statistic for the asymptotic is $-2\left[L(\widehat{\omega}) - L(\widehat{\Omega})\right] \sim X_I^2$. Note that in general the number of the degrees of freedom of the chi-square variable is given by the number of the explanatory variables in the model.

In many applied studies the researchers use all three probability models-linear, logit, and probit- on the same data and compare the result. The distinction among the three models can be summarized as follows:

Linear Probability model: $F(\alpha + \beta X_i) = \alpha + \beta X_i$

Logit : $F(\alpha + \beta X_i) = \frac{1}{1+e^{-\alpha-\beta X}}$

Probit : $F(\alpha + \beta X_i) = \int_{-\infty}^{\alpha+\beta X_i} \frac{1}{\sqrt{2\pi}} e^{-z^2/2} dz_i$

where F(.) represents a cumulative distribution function. This should be noted, though, that the values of the estimated coefficients are not comparable because the coefficients have a different interpretation in each model.

To facilitate comparison, Amemiya (1981) suggested the following approximate scaling adjustment:

$$\hat{\alpha}_{LP} \approx 0.25\hat{\alpha}_L + 0.5 \approx 0.4\hat{\alpha}_P + 0.5$$

$$\hat{\beta}_{LP} \approx 0.25\hat{\beta}_L \approx 0.4\hat{\beta}_P$$

where the subscript LP refers to the linear probability model, L to the logit model, and P to the probit model.

APPENDIX B

Questionnaire

Questionnaire # …………….

Interviewer…………………….Date……………………Supervisor…………………..

Time…………………………………

Place/Khet…………………………………………………….

[Interviewer: Read the following statement to the respondent] This interview is intended to assist the doctoral research of Mr. Panyapat Anuwatkhunnatham, a PhD candidate in Economics at School of Development Economics, NIDA. All information you provide will be held in strict confidence and will be used only for purposes stated for this study. Your answers will not be disclosed or released to others in any way that could identify you. If at any time you wish to stop the interview or not answer the specific question, this is entirely up to you. The interview normally lasts about 15 minutes.

[If interviewer read all above statement, then you should sign your signature]

Signature:………………………………………[Rate: 500, 1000, 1500, 2000, 2500]

A Public Demand for the Flood Prevention Program

[Interviewer: Please read these below statement and follow these conditions strictly]

1) The respondents in this survey must be taxpayers who are between the ages of 20 and 60 years old. Our survey will be conducted only in Bangkok area and all interviews will be conducted in Thai language. Also this study is not concerned with whether the respondent is originally from or whether he/she is Bangkokian.

2) Do not allow respondent to see this questionnaire. Interview has to narrate and explain to the respondents about questions, scenario, and story. Moreover the interviewer has to fill all of information taken from the respondent in this questionnaire by himself/herself.

…………………………………………………………………………………………

Part A Personal Information

[Interviewer] Please mark this sign [x] on the questionnaire form of fill the blank up

A1. Gender Male Female
A.2 Age years (Remarks: the age 20 years and 8 month is 20 years)
A.3 Marital status Single Married Windowed/Divorced/Separated
A.4 Educational level No schooling Elementary (6 years of schooling) Primary (9 years of schooling) Secondary (12 years of schooling) Pre-college/Vocational University Postgraduate Other (Please specify)………………….
A.5 Occupation Bureaucrat/Staff in the state-enterprise organization Business owner with salary-paid employees White collar worker in private firm Self-employed worker Worker in Agriculture sector Household Worker Others (Please specify)……………………….
A.6 Number of member living in the same household (including you)   person(s) Number of less than 15 years old child living in the same household person (s)
A.7 Monthly income before tax (on average)............................Baht

Part B Living Place Characteristic

B.1 Do you own your current living place? Owner Owner by installment Tenant Occupant Other (Please specify)…………..
B.2 Types of your living place House Townhouse Flat/Apartment living on the..............floor(s) Commercial building Condominium living on the ……..floor(s) Other (please specify) ....on the..............floor (s)
B.3 Living Place Structure Made of wooden Not made of wooden (please specify) ………….
B.4 Period of your stay in your living place………………………..year(s)
B.5 Expected period of your stay in your living place in the future...............................year(s)

Part C Geographic Characteristic

C.1 Distance of your living place from the main river □ far from the main river □ near to the main river □ not far or not near to the main river
C.2 Elevation of your living place □ situated in low-lying area □ situated in high area □ situated in not low or not high area

Part D Awareness, experience and expense of Flooding in 2011

D.1 Level of flood risk on your property □ No effect □ Very low □ Low □ Not high/not low □ High □ Very high
D.2 Experience of flood disaster in 2011 □ Yes □ No
D.3 Types of effect you encountered in flooding 2011

Effect	No effect					Very effect
	0	1	2	3	4	5
1.Life effect e.g. drawn injury	□	□	□	□	□	□
2. Health effect e.g. Leptospirosis, Intestine disease, Diarrhea, Cholera	□	□	□	□	□	□
3. Economic effect e.g. expense for repairing , Loss of income, Flood preventive expenditure	□	□	□	□	□	□
4. Psychological effect e.g. stress	□	□	□	□	□	□
5. Asset effect e.g. loss of asset while flooding	□	□	□	□	□	□

6. Scenery effect e.g. bad smell , polluted water	□	□	□	□	□	□
7. Other effects (please specify)	□	□	□	□	□	□

D.4 Expenditure on average for flood prevention…………………………….Baht

D.5 The required Assistances provided by Government

Required Assistances	No effect					Very effect
	0	1	2	3	4	5
1. provide updated information and accurate warning system	□	□	□	□	□	□
2. give instruction for flood preparation	□	□	□	□	□	□
3. provide sandbags for flood prevention	□	□	□	□	□	□
4. provide water pump for flood prevention	□	□	□	□	□	□
5. provide safety places for evacuation	□	□	□	□	□	□
6. improve drainage system to increase flow of water	□	□	□	□	□	□
7. provide relevant officers to take care of situation	□	□	□	□	□	□
8. Other (please specify)	□	□	□	□	□	□

D.6 The important Flood Protection Measures

Required Measures	No effect					Very effect
	0	1	2	3	4	5
1. cannel improvement	□	□	□	□	□	□
2.drainage system improvement	□	□	□	□	□	□
3.dam and reservoir construction	□	□	□	□	□	□
4.floodplain zoning / regulation	□	□	□	□	□	□
5. forest rehabilitation	□	□	□	□	□	□
6. more water pump installment	□	□	□	□	□	□
7.flood warning system improvement	□	□	□	□	□	□
8. Other (please specify)	□	□	□	□	□	□

Part E Hypothetical Situation on WTP for a Flood Prevention Program

[**Interviewer**: Please explain the following flood prevention scheme and hypothetical scenario to the respondent to make sure that he/she understands the situation]

Bangkok has been situated in very low-lying area which is more likely to be flooded. Damages occurred from flooding are unexpectedly more likely to be serious every year, especially flooding crisis in 2011, which gave both negatively direct and indirect effect to the victims in many aspects for example, business and household interruption causing temporary business close down and loss of job, health problem from flooding, transportation problem etc.

Therefore, in order to protect and reduce the negative effect and damage caused from flooding especially in mainly economic area such as Bangkok, Government has initiated to invest the flood control project for the purpose of flood prevention which will assumingly reduce the probability of flooding for 95%.

However, in the process of flood control project operation need a hugh amount of money for investment in such project. Therefore, in order to reduce government budget constraint to be spent on that particular project. Assume that government initiate to collect flood tax every year. This tax will be used in this flood control project including compensation to the flood victims and subsequent maintenance.

The willingness to pay question

E.1 Suppose the government would collect an additional flood tax in form of yearly income tax payment of 5,00 1,000 1,500 2,000 and 2,500 Baht to support this flood prevention scheme. Would you be willing and able to pay for this?

[Interviewer : Please choose the one option which most closely resembles your view by marking this sign ✓ on the given box and also do not read these below answers to the respondent]

[ ]Yes [Go to E.2]

[ ] Yes, but I could not pay this tax rate at the moment [Go to E.3]

[ ] Yes, if I had more money since I have had a lot of personal expenses to pay [Go to E.3]

[ ] Yes, but I would like to know what others think/or if other people agree [Go to E.3]

[ ] Yes, but this tax rate is too expensive [Go to E.3]

[ ] Yes, if this tax rate has been reduced [Go to E.3]

[ ] No [Go to E.3]

[ ] I have no idea/I do not know [Go to E.3]

E.2 Please explain why you would be willing and able to pay for supporting this flood prevention scheme

[Interviewer: Do not read the following list. Please choose the one option which most closely resembles your view by marking this sign ✓ on the given box]

[ ] This program benefits me and my family if the flooding has been reduced.

[ ] This scheme will provide positive externality for society.

[ ] The tax rate is not too expensive and is affordable

[ ] This program will benefit the next generation.

[ ] Other, specify…………………………

E.3 Please explain why you would **not** be willing and able to pay for supporting this flood prevention scheme

[Interviewer: Do not read the following list. Please choose the one option which most closely resembles your view by marking this sign ✓ on the given box]

[ ] No money

[ ] Do not see the benefit of this program

[ ] Do not think that my living place will get effected with flooding

[ ] Do not think that this program is effective to prevent flood in our society

[ ] Other, specify ……………………………

Part F [Interviewer read this following statement to the respondent]

"This is the end of interview. Thank you very much for your cooperation. I want to remind you again that the purpose of this study is the part of fulfill requirements for the degree of Doctor of Philosophy in Economics at School of Development Economics, NIDA. The aim of this PhD research study is to find out how much the general population would be willing and able to support a flood prevention scheme, so we have asked different respondents with different flood tax rates. So please do not be concerned if you hear that someone else in your community has been interviewed and asked about different rates than ones you and I have discussed"

APPENDIX C

Measuring Goodness of Fit

This measurement goodness of fit with respect to STATA has been divided into two main measures: a) Log-likelihood based and b) information measures. On this account, measures of fit can provide a rough index of whether a model is adequate. Nonetheless, there is no convincing evidence that selecting a model that maximizes the value of a given measure results in a model which is optimal in any sense other than the model's having a larger (or smaller) value of that measure. Although measures of fit provide some information, it is only partial information that must be assessed within the context of the theory motivating the analysis, past research, and the estimated parameters of the model being considered (Long and Freese, 2006).

a) Log-Likelihood Based Measure

STATA begins maximum likelihood iterations by computing the log likelihood of the model with all parameters but the intercept constrained to zero, referred to as L ($M_{\text{intercept}}$). The log likelihood upon convergence, referred to as M_{full}, is also listed. This information is normally presented as the first step of the iteration log and in the header for the estimation results.

- Chi-squared test of all coefficients: An LR test of the hypothesis that all coefficients except the intercept are zero can be computed by comparing the log likelihoods: $= 2\ln L(M_{FULL}) - 2\ln L\big(M_{intercept}\big)$. This statistic is sometimes designed as G^2.

- $\mathbf{R^2}$ in the LRM : STATA command will report the standard coefficient of determination, which can be defined differently as

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y}_i)} = \frac{V\hat{a}r(\hat{y})}{V\hat{a}r(\hat{y}) + V\hat{a}r(\hat{\varepsilon})} = 1 - \left\{\frac{L\big(M_{intercept}\big)}{L(M_{FULL})}\right\}^{2/N}$$

The adjusted R^2 is defined as

$R^{-2} = \left(R^2 - \frac{K}{N-1}\right)\left(\frac{N-1}{N-K-1}\right)$ where K is the number of independent variables.

- McFadden's R^2 : McFadden's R^2, also known as the "likelihood-ratio index", compares a model with just the intercept to a model with all parameters. It however is defined as

$$R^2_{McF} = 1 - \frac{\ln L(\widehat{M}_{FULL})}{\ln L(\widehat{M}_{intercept})}$$

If model $M_{intercept} = M_{full}$, R^2_{McF} equals 0, but R^2_{McF} can never exactly equal 1.

Also R^2_{McF} normally increases as new variable are added, an adjusted version is also available.

$$R^{-2}_{McF} = 1 - \frac{\ln \hat{L}(\widehat{M}_{FULL}) - K^*}{\ln \hat{L}(\widehat{M}_{intercept})}$$

where K^* is the number of parameters (not independent variables).

- Maximum likelihood R^2: Another analogy to R^2 in the LRM was suggested by Maddala:

$$R^2_{ML} = 1 - \left\{\frac{L(M_{intercept})}{L(M_{FULL})}\right\}^{2/N} = 1 - exp(-G^2/N)$$

Therefore R^2 is known as the Cox-Snell R^2

- Cragg and Uhler's R^2: Since R^2_{ML} reaches a maximum of only $1 - L(M_{intercept})^{2/N}$ Cragg and Uhler suggested a normed measure:

$$R^2_{C\&U} = \frac{R^2_{ML}}{maxR^2_{ML}} = \frac{1 - \left\{\frac{L(M_{intercept})}{L(M_{FULL})}\right\}^{2/N}}{1 - L(M_{intercept})^{2/N}}$$

This R^2 is also known as the Nagelkerke R^2.

- Efron's R^2: For binary outcomes, Efron's psedo-R^2 defines

$\hat{y} = \hat{\pi} = \hat{P}r(y = 1/x)$ and equals

$$R^2_{Efrom} = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{\pi}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2}$$

- V(y*), V(ε), and Mckelvey and Zavoina's R^2 : Some models can be defined in term of a latent variable y*. This includes the models for binary or ordinal outcomes such as logit, probit, ologit, oprobit, as well as some models with censoring: tobit, cnreg, and interg. Each model is defined in terms of a regression on a latent variable y*.

$y^* = x\beta + \varepsilon$

Using $V\hat{a}r(\hat{y}^*) = \hat{\beta}V\hat{a}r(x)\hat{\beta}$, Mckelvey and Zavoina proposed

$$R^2_{\mathrm{M\&Z}} = \frac{V\hat{a}r(\hat{y}^*)}{V\hat{a}r(y^*)} = \frac{V\hat{a}r(\hat{y}^*)}{V\hat{a}r(\hat{y}^*) + Var(\varepsilon)}$$

In model for categorical outcomes, $Var(\varepsilon)$ is assumed to identify the model.

- Count and adjusted count R^2: Observed and predicted values can be used in models with categorical outcomes to compute what is known as the count R^2. Consider binary case where the observed y is 0 or 1 and $\pi_i = \hat{P}r(y = 1/x)$. Define the expected outcomes as $\hat{y}_i = 0$ if $\hat{\pi}_i \leq 0.5$ or 1 if $\hat{\pi}_i > 0.5$. A seemingly appealing measure is the proportion of correct prediction, referred as the count R^2, $R^2_{Count} = \frac{1}{N}\sum_j n_{jj}$ where the n_{jj}' s are the number of correct predictions for outcome j.

The count R^2 can give the faulty impressive that the model is predicting so well. In a binary model without knowledge about the independent variables, it is possible to correctly predict at least 50% of the cases by choosing the outcome category with the largest percentage of observed cases. To adjust for the largest row marginal.

$$R^2_{AdjCount} = \frac{\sum_j n_{jj} - \max_r(n_{r+})}{N - \max_r(n_{r+})}$$

The adjusted count R^2 is the proportion of correct guesses beyond the number that would be correctly guessed by choosing the largest marginal.

b) Information Measures

Information measures can be used to compare both nested and nonnested models.

- AIC: Akaike's (1973) information criterion is defined as

$$AIC = \frac{\{-2\ln \hat{L}(M_k) + 2P_k\}}{N}$$

where $\widehat{L(M_k)}$ is likelihood of the model and P_k is the number of parameters in the model (e.g. K+1 in the binary regression model, where K is the number of regressors).

Ceteris Paribus, the model with the smaller AIC is considered the better-fitting model. Another definition of AIC is equal to N times the values we report.

- BIC and BIC': The Bayesian information criterion (BIC) has been proposed by Raftery (1996) as a measure to compare nested and nonnested models. There are at least three ways in which the BIC statistics is defined. Even though this can be confusing, the differences are not important, as we will show after presenting the various definitions.

Consider the model M_k with deviance $D(M_k)$. BIC is defined as $BIC_k = D(M_k) - df_k \ln N$ *where* df_k is the degrees of freedom associated with the deviance. The more negative the BIC_k, the better the fit. A second version of BIC is based on the LR chi-squared with $df_k{}'$ equal to the number of regressors (not parameters) in the model. Then $BIC'_k = -G^2(M_k) + df'_k \ln N$. Again the more negative the BIC'_k, the better the fit. A third definition, the one that is included with estimates table with the stats(bic) option and in estat ic, is $BIC^s_k = -2 \ln N\hat{L}(M_k) + df^s_k \ln N$ where df^2_k is the number of parameters in the model including auxiliary parameters such as α in the negative binominal regression model.

APPENDIX D

Training of Enumerators

The job of training and managing enumerators was very important and we therefore tried to follow the advice from Whittington (2002). In the recruitment process we used experienced enumerators who are not too extroverted or would not try to influence the views of the respondent where possible. Students, in particular may be a good choice, but then we had to make sure that they strictly followed the instructions in the questionnaire and did not try to interpret the questions on their own. We picked more enumerators than needed, because we wished to sort out the ones that performed well in the training session.

In the training of the enumerators it was vital that they understood as well that they must follow the script exactly, and also adjust themselves during face-to-face interviews in accordance with the respondent's characteristics. In addition it was crucial that the enumerator did not attempt to convince the respondents that they should be willing to pay for the hypothetical goods or services offered. Whittington listed a number of good interview practices and we will go through them in the training.

1. Read every question exactly as written in the questionnaire – do not improvise

Comment: Research on the art of asking questions shows that the precise wording of questions may significantly affect a respondent's answers. If each enumerator develops her own way of asking questions, one can never be sure that the same question is being asked. We need to make sure that each respondent is answering the same question. Reading the question exactly also makes the interview shorter.

2. Read the question slowly enough so that the respondent can understand

Comment: An enumerator has seen each question hundreds of times before. It's natural for the enumerator to want to go quickly over a question that he knows so well, but it's the first time for the respondent. The enumerator thus needs to speak slowly.

3. Wait for the respondent to answer

Comment: Some enumerators will read the question once, then look up and repeat the question, and sometimes even start a lengthy explanation, before letting the respondent answer! Ask once very clearly, and let the respondent think.

4. If the respondent can't answer, repeat the question

Comment: The respondent may not have been paying attention the first time. If, after the second reading the respondent still can't answer, go to the next question.

5. Remain absolutely neutral about the respondent's answer

Comment: Never express surprise, approval, disapproval, judgment, or doubt about a response. Don't let your facial expression change. Just record the answer. For example' if a respondent says that they would be willing to pay a very large amount for good or service, the enumerator should not say, "wow!" If a respondent gives an answer that is factually wrong, the enumerator should not reveal that he knows the answer is incorrect.

6. Do not act embarrassed about a respondent's answers to sensitive question

Comment: This will increase the embarrassment of the respondent, not reduce it. Be very matter of fact.

7. Never suggest an answer unless the instructions say to read the answers to the respondent

Comment: For example, if the respondent is having difficulty estimating the most he will pay for a good or service, do not prompt him with suggestions like "would you pay more than US$xx? More than US$yy? Less than zz"

8. Don't repeat the respondent's answer

Comment: This is repetitive and wastes time.

9. Conduct the interview in private

Comment: That means the interview should not be in earshot of other people in the household. If someone doesn't want to leave, the enumerator should offer to interview him or her separately. If they still won't leave, then the enumerator should explain to the respondent that he will have to return later.

10. Do not give advice to respondents on personal matters

Comment: Enumerators should refer respondents to the appropriate authorities for answers to questions that may arise that are outside the scope of the interview.

11. Answer directly to respondent may have about the purpose of the survey

Comment: Respondents are entitled to know the purpose of the survey and how they have been selected to be interviewed. The enumerator should not be reluctant to take time to provide clear, detailed answer to such questions.

12. Listen carefully to the respondent's answer

Comment: It is very off putting to the respondent if the enumerator is inattentive. Moreover, the respondent may be offering an answer that is in fact different than it first appears to be. In such cases the enumerator needs to be listening carefully to hear what is actually being said.

BIOGRAPHY

Name	Panyapat Anuwatkhunnatham
ACADEMIC BACKGROUND	Bachelor's Degree in Pharmaceutical Science from Chulalongkorn University, Bangkok, Thailand 2003 Master's Degree in Management at Mahidol University, Bangkok, Thailand in 2006
PRESENT POSITION	Technical Customs Officer, Thai Customs Departmnet
EXPERIENCES	Awarded second-class honor medal in Pharmaceutical Science, Faculty of Pharmaceutical Science, Chulalongkorn University, Bangkok, Thailand