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1

Panyapat Anuwatkhunnatham
Udomsak Seenprachawong

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Panyapat Anuwatkhunnatham[1]
Udomsak Seenprachawong[2]

บทคัดย่อ

การศึกษานี้เป็นการศึกษาเรื่อง ภาษีน้ำท่วม เพื่อสนับสนุนโครงการป้องกันน้ำท่วมระดับประเทศของรัฐบาล โดยประเมินมูลค่าความเต็มใจที่จะจ่ายภาษีน้ำท่วมเป็นรายปี ในรูปแบบของภาษีรายได้เพื่อสนับสนุนโครงการดังกล่าวของประชาชนวัยทำงานและมีรายได้ ที่อาศัยอยู่ในกรุงเทพมหานครซึ่งเป็นพื้นที่เศรษฐกิจที่สำคัญยิ่งของประเทศที่ต้องได้รับ การปกป้องจากโครงการป้องกันน้ำท่วมของรัฐบาล โดยมีวัตถุประสงค์เพื่อลดภาระค่าใช้จ่ายของรัฐบาลในการป้องกันน้ำท่วม

การศึกษานี้ใช้วิธีประเมินมูลค่าโดยการสัมภาษณ์เป็นหลัก โดยสัมภาษณ์ประชากรตัวอย่างผู้เสียภาษีอายุ 20 - 60 ปี จำนวน 600 คน ในเขตพื้นที่กรุงเทพมหานคร เพื่อประเมินมูลค่า ความเต็มใจที่จะจ่ายภาษีน้ำท่วมเพื่อสนับสนุนโครงการป้องกันน้ำท่วมของรัฐบาล โดยกำหนดอัตราจ่ายภาษีน้ำท่วมเริ่มต้น เท่ากับ 500 1,000 1,500 2,000 และ 2,500 บาทต่อปี ทั้งนี้ นอกเหนือจากปัจจัยด้านรายได้ การศึกษานี้ยังแบ่งประชากรตัวอย่างตามลักษณะพื้นที่ที่อยู่อาศัยตามหลักทางภูมิศาสตร์เพื่อใช้ในการออกแบบระบบภาษีน้ำท่วมให้มีความเป็นธรรมและมีประสิทธิภาพตามหลักเศรษฐศาสตร์

ผลการศึกษา พบว่า ค่าเฉลี่ยความเต็มใจที่จะจ่ายภาษีน้ำท่วมเพื่อสนับสนุนโครงการดังกล่าว เท่ากับ 1,878 บาทต่อปี สำหรับประชากรตัวอย่างที่อาศัยอยู่ในพื้นที่ต่ำ และ 1,464 บาทต่อปี สำหรับประชากรตัวอย่างที่อาศัยอยู่ในพื้นที่สูง นอกเหนือจากปัจจัยทางด้านความสูง/ต่ำของพื้นที่ รายได้และอัตราจ่ายภาษีน้ำท่วมเริ่มต้นเป็นปัจจัยที่มีความสำคัญสำหรับประชากรกลุ่มตัวอย่างในการตัดสินใจว่าจะสนับสนุนโครงการนี้หรือไม่ ทั้งนี้ การศึกษานี้เสนอแนะให้รัฐบาลใช้วิธีการเก็บภาษีน้ำท่วมแบบถดถอยตามอัตรารายได้ ร่วมกับการกำหนดอัตราภาษี ที่แตกต่างกันตามลักษณะพื้นที่ทางภูมิศาสตร์ เพื่อสนับสนุนโครงการป้องกันน้ำท่วมของรัฐบาล

คำสำคัญ: ภาษีน้ำท่วม ความเต็มใจที่จะจ่าย การประเมินมูลค่าโดยวิธีสมมติเหตุการณ์ โครงการป้องกันน้ำท่วม

[1] Ph.D. Candidate, School of Development Economics, National Institute of Development Administration

[2] Associate professor, School of Development Economics, National Institute of Development Administration

Abstract

This study has examined the issue of the public support for the provision of "a yearly flood tax for national flood prevention scheme" by estimating 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 in Bangkok where they will be well protected from national flood control project because of economic area reason , with a yearly payment as part of their yearly income tax.

With the main use of contingent valuation method (CVM), a 600 sample surveyed study asked 20-60 years old taxpayers in Bangkok to elicit their willingness to pay (WTP) to support this flood prevention scheme with an initial tax payment of 500, 1,000, 1,500, 2,000 or 2,500 baht/year respectively. Apart from income factor, 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 study found that the mean WTP values for a flood prevention scheme were 1,878 baht/year for those who have lived in low-lying area and 1,464 baht/year for those who have lived in high elevated 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 execute a progressive tax with differentiated rates according to geographic characteristic to fund this scheme when a flood prevention program becomes available.

Keywords: Flood Tax, Willingness to pay (WTP), Contingent valuation method (WTP), Flood Prevention Program

19/2

1 Introduction

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 (ADRC, 2002 and Myers, 1997).

Thailand has been more likely to be effected by flooding especially Bangkok, 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. In order to prevent flood disaster with sustainable manner, Government should initiate national flood prevention scheme. However, implementation of such 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 government to consider in designing 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 prevention project, especially Bangkok where it is the backbone or center of business and commerce in Thailand, can share responsibility, hence to reduce government fiscal burden, to solve this problem.

Table 1: Breakdown of economic Losses of Flood Disaster in 2011

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

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 revenue from the whole government source for investing in flood prevention scheme in order to reduce the government budget constraint. It involves analysis of the factors determining and influencing the household's willingness to pay for flood control project. In addition, this study also compare willingness to pay estimates obtained by mean of two different evaluation techniques: actual preventive expenditures by using OLS and tobit model and hypothetical willingness to pay for flood control improvement by using probit model for consistency and compatibility approach by making survey to 600 households who had worked and lived in Bangkok, aged between 20 - 60 years old 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.

2 Types of Mechanism

There are two types of mechanism dealing with flooding which are command and control mechanism and market - based meachanism.

2.1 Command and Control Mechanism

Command and control mechanism is traditional response to flooding in which the Government solely invests in flood prevention scheme. In addition, government has to provide disaster assistance, flood compensation and relief to victims after flooding

occurred. The advantage of this measure is simple to implement. However, there are many major disadvantages which are as follow;

Fiscal Burden: the Government solely invests in flood prevention scheme. In addition, government has to provide disaster assistance such as flood compensation and relief to victims that finally causes government fiscal burden.

Arbitrary and subjective rather than rational economic grounds: it is not clear in which cases floods damage will be compensated. These decisions are influenced by political will and public pressure. The benefits from disaster assistance provided by government are less certain and less complete.

Economic loss: flood prevention investment and disaster compensation by government may hamper economics development broadly if disaster relief is financed through additional taxes or reduced public investment in other areas that benefit for long term country development such as education and health.

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.

2.2 Market - based Mechanism

Theoretically, there are two types of market-based mechanism dealing with flooding which are flood insurance and flood tax, accordingly.

2.2.1 Flood Insurance

Flood insurance is a system of protection against losses from flooding by using risk-sharing principle in which shares the risk on a wide enough population. 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. However, there are several problems exist that make it difficult to establish a pure private market that is why flood insurance is not well marketable in Thailand. 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.

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: Potential Challenges in Adopting Flood Insurance for Developing Countries

Supply side factors	- Difficulty in assessing risk and vulnerability before disaster - Difficulty in estimating damage after the disaster - High administration costs - Limited access to reinsurance market - Global climate change
Demand side factors	- High premium due to limited risk collective - Limited awareness and information - Moral hazard problem (relying on government's disaster relief) - Low income
Market and government factors	- Lack of relevant legislations and policies - Lack of clear partnership scheme between the government and the private sector

Source : Author

19/2

2.2.2 Flood Tax

Flood tax is a system of protection against financial loss from flooding by collecting money in form of flood tax. 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. From the economic point of view, if those people benefit of such

flood tax 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.

3 Flood Tax Base

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.

3.1 Asset Tax Base

Levying flood tax is based on asset tax, such as land and property value. 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. It is hypothesized that the more severe the flood experience, in term of greater depth, longer duration, the grater the decline in land value. Therefore, 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.

3.2 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.

3.3 Consumption Tax Base

The good example of consumption tax base is value added tax (VAT) by increasing the current tax rate. However, 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.

3.4 Income Tax Base

For income tax base, it is very easy and simple for implementation because Thailand had the income base system already implemented. 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 3: 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

Source: Author

4 Countries implementing Flood Tax

4.1 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 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, progressive taxing system is implemented.

4.2 Pakistan

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. 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.

4.3 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 4: Existing Flood Tax Base implemented in Countries

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

Source: Author

5 Literature Review

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 many countries with various target population and sample sizes and different scales aiming to identify key factors influencing the willingness to pay and estimate the willingness to pay for flood control project such as in Virginia, United states of America (Eric Thunberg and Leonard Sahbman, 1991), Wisconsin, United states of America (Margaret C. Duan, David Clark 2000), Bangladesh (Roy Brouwer, Sonia Akter, Luke Brander and Enamul Haque,2003), Wisconsin , United states of America (David E. Clark, Robert griffin, and Vladimir Novoty 2005), Japan (Guofang Zhai 2006), Thailand (Nida Puttipiriya 2009), and Thailand (Pantiwa. S 2010).

19/2

Table 5: The Studies of Willingness to Pay for Flood Control Project

Study	The country case study	Target population	Size
Eric Thunberg and Leonard Sahbman (1991)	Virginia, USA	owners of flood prone parcels within the city of Roanoke, Virginia	134
Margaret C. Duan, David Clark (2000)	Wisconsin, USA	households in the Menomonee River and Oak Creek watersheds	999

Table 5: (Conts.)

Study	The country case study	Target population	Size
Roy Brouwer, Sonia Akter, Luke Brander and Enamul Haque (2003)	Bangladesh	floodplain residents currently living without any flood protection along the river	700
David E. Clark, Robert griffin, and Vladimir Novoty (2005)	Wisconsin, USA	residents of two impacted watersheds in the Milwaukee area Wisconsin	570
Guofang Zhai (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

Source: Authors

For the two relevant studies done in Thailand, Nida Puttupiriya (2009) studied the willingness to pay and factors influencing WTP to prevent flooding in household sector at district level which is Changkhlan dub-district Mueang district, Chiang Mai province by using CVM double bounded method. Similar to the study of Pantiwa. S (2010), she studied the WTP for improving the quality of Pasak Jolasid dam with the aim for flood prevention in Bangkok in both household and business sectors including factors influencing the WTP by using CVM double bounded method. In addition, there have not been studies on other disasters in Thailand.

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 national flood control project designed by government. Therefore, many key factors influencing the willingness to pay for national flood control project including calculation of willingness to pay for flood tax, with the aim of

formulating efficiency national flood tax scheme, remain unexamined. On the whole reviewed studies of demand for flood control project were 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. Therefore, 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 reduced risk of flooding and corresponding impacts on their life and livelihood, is mostly applicable and suitable in this area.

Table 6: The Outcomes of Willingness to Pay Amounts among Seven different Studies

Study	The willingness to pay amounts on the flood control project
Eric Thunberg and Leonard Sahbman (1991)	56% people favored the tax increase to support the project but WTP in this study was not calculated
Margaret C. Duan, David Clark (2000)	WTP in this study was not calculated
Roy Brouwer, Sonia Akter, Luke Brander and Enamul Haque (2003)	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)
Guofang Zhai (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

Source: Author

Most of 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. In addition, apart from income and demographic factors, attitude and belief factors are important to control for when valuing any public good using WTP.

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). 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.

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). Three variables reflect objective indicators of the flood risk faced by the respondent based on geographic characteristics normally used in many studies which are 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 accordingly.

6 Model

There are a number of ways to estimate a valuation of the reduction of the current flood risk levels in exchange for supporting flood control project. This include 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 in order to make a comparison for consistency and compatibility.

6.1 CVM Model

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 reduced risk of flooding and corresponding impacts on their life and livelihood. This method is designed to estimate the willingness to pay (WTP) amount for flood tax.

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 which the resulting benefits are both direct and indirect. 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).

Therefore, flood control projects have private good attributes as well as their obvious public good attributes. 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 reflecting the advantage of CVM over the others.

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 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; and risk perception expected damage from flood (D). The relevant variables are mostly come from both economic theories behind and the reviewed previous studies. These dependent variables on our model will be described as follows:

$$WTP_i = f\ (R_i, Y_i, H_i, Z_i, Ho_i, F_i, G_i, D_i)$$

Table 7: 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
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

Table7: (Conts.)

Variable	Description	Expected sign
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

Source: Author

6.2 Preventive Expenditure Model

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 flooding. These may be understood as a lower bound (or

minimum estimate) on the cost of flood protection and willingness to pay for preventing it.

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 preventive expenditure model are same as the variables used in the CVM model except Expense variable which, in the CVM model treated as independent variable, is treated as dependent variable, instead, as shown in table 8.

Table 8: 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
Household	Number of household members (continuous, persons)	Negative
Children	if 1 = respondent has children living in the same household, 0 = otherwise	Negative/Positive

Table 8: (Conts.)

Variable	Description	Expected sign
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

Source: Author

7 Data Collection

7.1 Focus Group

Before the questionnaire had been designed and written, our study conducted 6 focus groups, pre and post-questionnaires focus groups. 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. 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.

7.2 Pre Test

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. 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 per year respectively.

7.3 Sampling Technique

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. For the first stage we sampled 6 districts or "khet" in Bangkok with variation of geographic characteristic where they either suffer or not suffer from flooding disaster in 2011. 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.

7.4 Location and Population

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.

7.5 Hypothetical Scenario

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 huge 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."

8 Results

A total of 600 individuals who are currently working 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.

8.1 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 2.86 persons (Table 9).

Table 9: 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
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

Source: Author

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 10: 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: NSO

Table 10 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.

8.2 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 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 11: 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 - 1 meter), 0 = otherwise	0.55	0.50
Area 1	if 1 = situated in area of 1.5 - 2.5 meter height, 0 = otherwise	0.32	0.02
Area 2	if 1 = situated in area of 1 - 2 meter height , 0 = otherwise	0.083	0.01
Area 3	if 1 = situated in area of 0.5 - 1 meter height, 0 = otherwise	0.43	0.02
Area 4	if 1 = situated in area of 0 - 0.5 meter height, 0 = otherwise	0.17	0.02

Source: Author

8.3 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 on 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 12: Awareness, experience and expense of Flooding in 2011

Variable	Descriptive	Mean	S.D.
Exp	if 1 = have experienced and been 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

Source: Author

8.4 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?

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. 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 13: 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			

Table 13: (Conts.)

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*
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	1.335	0.156			
Sensitive					
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

Source: Author

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 13, 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. It is because male have more ability to earn money than female. For OCCUPATION, those who have worked in public sectors 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. It is because they have a deep and long relationship with their living place. 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. It is because 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 reflected by higher willingness to pay. 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 realized that they have been more likely to suffer from flooding comparing with those respondents living in high elevated 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. It is because the single people have more ability to pay flood tax than married people who have more budget constraint such that they have not had extra-money spent for flood prevention 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 14: Income Elasticity of the Full Demand

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

Source: Author

Consistent with Table 14, it also confirmed that 1% increase in income will lead approximately a 3% rise in demand for flood prevention scheme.

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 15: Model of the defensive Expenditure for Flood Prevention Program

Model 2 : model defensive expenditure of the 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		

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 criterion	10.747
Prob (F Stat)	0.00	Log likelihood	-3205.635
Durbin-Watson	1.88		

Source: Author

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 15, 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 because of the feeling of ownership. 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. It is because when flooding occurs, they are more likely to get negative impact than the others. 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 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 in the only first floor constituted living place which has been to be directly and seriously affected by flooding, they are more willing to pay for their own flood prevention.

8.5 The Estimation of Mean Willingness to Pay (WTP)

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 16: 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	1,464.28
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	1,286.00

Source: Author

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-elevated 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.

As for various type of Mean WTP (See Table 17), 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-elevated 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.

Table 17: 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		

Source: Author

19/2

With the method of maximum likelihood estimation, the results of the probit model were presented in Table 17 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-elevated area because those who lived in low area would benefit from our flood prevention scheme.

9 Discussion and Conclusion

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. Therefore, the calculated WTP obtained from this study was very useful for government to execute a plan and could be used as a database or reference in designing flood tax collection for effectively national flood control project implementation with least people's resistance in term of willingness to pay.

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 impact in terms of life, social and economic impacts which resulted in human casualties, damage to properties, and disruption of economic activities in the affected area. Second, the government could raise money to subsidize this program by using a progressive tax with differentiated geographical living place areas for the purpose of equity and efficiency manner. 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-lying living place areas with respect to sponsoring this program.

Table 18: Income Tax Payment for supporting the Flood Prevention Scheme

"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

Source: Author

Table 18, 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 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 [3], 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-elevated 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 %[4] tax on annual income of in excess of 240,000 baht has been collected. Someone, for example, with his annual income as 250,000 baht living in the low-lying 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.

10 Future Research

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.

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. There are some advantages in using the choice experiment technique over CVM 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

[3] 240,000 baht is approximately minimum income per year in total before other expense deductible that legally is not taxed

[4] 3% is income elasticity

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.

In addition, 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 help researcher to get more reliable results and finally come into more efficient 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 beyond the scope of this study.

References

Akter, Sonia, & Fatema, Naureen. (2011). ***The role of microcredit and micro insurance in coping with natural hazard risks.*** European Association of Environmental and Resource Economists, 18th Annual Conference, 29 June - 2 July 2011, Rome.

Asian Disaster Reduction Center (ADRC). (2002). ***ADRC natural disasters data book***. Sendai: Asian Disaster Reduction Center.

Bateman, Ian J., Langford, Ian H., & Graham, Andreas. (1996). Willingness to pay to prevent saline flooding in the Norfolk broads. ***Journal of Environmental Planning and Management,*** 50(3), 363-380.

Billy, M., & Polic, M. (2005). Public perceptions of flood risk, flood forecasting and mitigation. ***Natural Hazards Earth System Science,*** 5, 345-355.

Botzen, W.J. Wouter, & Van Den Bergh, Jeroen C.J.M. (2012). Monetary valuation of insurance against flood risk under climate change. ***International Economic Review,*** 53(3), 1005-1026.

Botzen, W.J.W., Aerts, J.C.J.H., & Ven Den Bergh, J.C.J.M.. (2008). Willingness of homeowners to mitigate climate risk through insurance. ***Ecological Economics***, 68(8-9), 2265-2277.

Brouwer, R., & Akter, S. (2010). Informing micro insurance contract design to mitigate climate change catastrophe risks using choice experiments. ***Environmental Hazards***, 9(1), 74-88.

Brouwer, Roy, & Bateman, Ian J. (2005). Temporal stability and transferability of models of willingness to pay for flood control and wetland conservation. Water Resource research, 41(3).

Brouwer, Roy, Akter, Sonia, Brander, Luke, & Haque, Enamul. (2003). Economic valuation of flood risk exposure and flood control in a severely flood prone developing country. ***Journal of Environmental Economics and Management***, 32, 251-270.

Brouwer, Roy. (2006). Choice modeling of climate change flood risk mitigation and disaster management. ***Journal of Risk and Uncertainty,*** 17, 5-25.

Browne, Mark J., & Hoyt, Robert E. (1999). The demand for flood insurance empirical evidence. ***Journal of Insurance***, 19, 47-65.

Browne, Mark J., & Knoller, Christian. (2012). ***Risk perception, insurance agent, and the demand for flood insurance.***

Clark, David E., Griffin, Robert, & Novoty, Vladimir. (2005)***. Assessing the determinants of WTP for urban flood control: the role of location, demographic and attitudinal factors***. Working Papers and Research from Marquette University, Center for Global and Economic Studies and Department of Economic, no. 503.

Duan, Margaret C., & Clark, David. (2000). ***Flood risk and contingent valuation willingness to pay studies***. Technical report no. 6 Milwaukee WI: Institute for Urban Environmental Risk Management, Marquette University.

Finucane, Melissa L. et al. (2000). The afect heuristic in judgments of risks and benefits. ***Journal of Behavioral Decision Making***, 13, 1-17.

Fire, Stephen G., & Carson, James M. (2015). Catastrophe and the demand for life insurance. ***Journal of Insurance Issues***, 38(2), 125-156.

Greene, William H. (2008). ***Econometric analysis***. 6 th ed. New Jersey: Pearson Prentice Hall.

Gujarati, Damodar. (2003). ***Basic econometrics***. 4th ed. New York : McGraw-Hill.

Keller, Carmen et al. (2006). The roles of the affect and availability heuristics in risk communication. ***Risk Analysis,*** 26(3), 631-639.

Kennedy, Peter. (2008). ***A guild to econometrics***. 6th ed. Malden: Blackwell.

Kmenta, Jan. (1986). ***Elements of econometrics***. 2nd ed. New York: Macmillan.

Landry, Craig E. (2005). ***Weathering the storm: measuring household WTP for flood reduction in post Katrina New Orleans***. Working paper from Department of Economics, Appalachian State University, 9.

Lee, Jihyun, Perolia, Danial R., & Ferraez, Will T. (2011). ***Flood insurance demand along the gulf and Florida coast***. Southern Agricultural Economics Association, 2011 Annual Meeting, February 5-8, 2011, Corpus Christi, Texas.

Long, Scott J., & Freese, Jeremy. (2006). ***Regression models for categorical dependent variable using STATA***. 2nd ed. Taxas: Stata Press.

Myers, M. F. (1997). ***Trends in flood***. Paper presented at the Workshop on the Social and Economic Impacts of Whether, April 2-4, Colorado.

Nida Puttipiriya. (2009). ***An evaluation of WTP to prevent flood prevention at Changkhlan sub-district, Mueang district, Chiang Mai province***, Kasetsart University.

Pantiwa, S. (2010). ***WTP for and factor determination of flood prevention tax in Bangkok by Pasak Jolasid dam,*** Kasetsart University.

Peacock, Walter E., Brody, Samuel, D., & Highfield, Wesley, E. (2005). Hurrican risk perceptions among Florida's single family homeowners. ***Landscape Urban Plan***, 73(2), 120-135.

Petrolia, Daniel R., Landry, Craig E., & Coble, Keith H. (2012). ***Risk preferences, risk perceptions, and demand for flood insurance***. Retrieved from http://dx.doi.org/10.2139/ssrn.1843326

Pindyck, Robert, & Rubinfeild, Daniel. (1998). ***Economic forecasting-econometric Model***. 4th ed. Singapore: McGraw-Hill.

Siegrist, Michael, & Gutseher, Heinz. (2006). Flooding risk: a comparison of lay people's perceptions and expert's assessments in Switzerland. ***Risk Analysis***, 20(1), 1-11.

Slovic, Paul. et al. (2001). ***Heuristics and biases: the psychology of intuitive judgment***. New York: Cambridge University Press.

Thunberg, Eric, & Sahbman, Leonard. (1991). Determinants of landowner's willingness to pay for flood hazard reduction. ***Journal of American Water Resources Association,*** 27(4), 657-665.

Verbeek, Marco. (2008). ***A guide to modern econometrics***. 3rd ed. West Sussex: Wiley.

World Bank. (2010). ***Thai flood 2011: rapid assessment for resilient recovery and reconstruction planning***. Washington, DC: World Bank.

Zhai, Guofang. (2006). Public preference and WTP for flood risk reduction. ***Journal of American Water Resources Association***, 42(4), 927-940.