Methods for determining how much to spend on flood prevention: An empirical case study in the Philippines

PhD thesis submitted by

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Zoleta-Nantes (2002) documented the flood experiences of street children and urban poor household in Metro Manila, Philippines. One male child, Junjun, quipped:

> *"We have experienced flooding inside our house under the bridge as far back as I can remember. Our house is made of corrugated iron and plywood scraps. Flood water enters our shacks and carriers it away together with our few belongings. When the floods subside we collect materials from the river to build our shanty with the help of our neighbors. I also encounter flood water on streets. If the flood is deep enough, my friends and I splash or run around or swim in it. I walk, wade and swim during periods of flooding to get to the street intersections where I beg. I know that it will flood when the typhoons come"* (p. 256).

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Cheryl Joy Fernandez May 2016

Declaration on Ethics

The research presented and reported in this thesis was conducted within the guidelines for research ethics outlines in the National Statement on Ethics Conduct in Research Involving Human (1999), the Joint NHMRC/AVCC Statement and Guidelines on Research Practice (1997), the James Cook University Policy on Experimentation Ethics Standard Practices and Guidelines (2001). The proposed research methodology received clearance from the James Cook University Experimentation Ethics Review Committee (Approval Number: H4875).

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Acronyms

CV Contingent valuation

DCC Disaster Coordinating Council

DEFRA Department for Environment, Food and Rural Affair

FD Flood damage

FGD Focus group discussion

IPCC Intergovernmental Panel on Climate Change

IV Instrumental variable

JCU James Cook University

LGU/LDC Local government unit/ local development council

LS Life satisfaction

MRS Marginal rate of substitution

NDCC National Disaster Coordinating Council

OCD Office of Civil Defence

PC Payment card

PCA Principal Component Analysis

PD Presidential Decree

PTSD Post-traumatic Stress Disorder

PV Predicted value

SWB Subjective well-being

UN United Nations

UNDP United Nations Development Program

UN/ISDR United Nations Inter-Agency Secretariat of the International Strategy for Disaster Reduction

WB World Bank

WTP/WTA Willingness to pay/willingness to accept

Abbreviations

BN billion

AU$ Australian dollar

M million

US$ US dollar

Abstract

Flood prevention/mitigation is an important component in disaster management and plays a key role in the well-being of communities all over the world. Typhoons and floods are predicted to become more severe and to occur more frequently in many areas (IPCC, 2014; UNU-EHE, 2014). Moreover, these events are likely to impact more people, particularly in less affluent countries, where populations are increasing in urban, often low-lying areas. Non-excludability and non-rivalry of (most) flood prevention strategies provide a disincentive for the private sector to provide them. Governments have planned and executed many strategies to prevent flood impacts – although budgets are limited. The central question addressed in this dissertation is thus *'how much should be spent on flood prevention/mitigation programs.'* I use three economic methods to address that question, each with its own aim, namely to:

1) Determine how much damage (to households) could be avoided if one were able to prevent flood (flood damage assessment);
2) Determine how much households are willing to pay to avoid future flood damages (contingent valuation or CV method); and
3) Determine the impact of flood damages on life satisfaction (LS), and the amount of income that would need to be paid to flood victims to *'compensate'* them (i.e. to hold LS constant) for the flood damage (life satisfaction or LS method).

The Metropolitan Iloilo (MI) of the Philippines is the case study region. This region is an ideal one in which to undertake the research because the country is one of the most vulnerable countries in the world in terms of disasters (Yusuf & Francisco, 2009;

UNU-EHS, 2014), yet expenditure on flood prevention programs in regional areas is inadequate (Benson, 2009; Lasco & Delfino, 2010; Iloilo City Government, 2010). The area also has a varied cross-section of *barangays* (communities/villages) and households, located near and far from rivers/creeks and with different socio-demographic characteristics. It is thus a good one in which to consider the differential impact of floods on different demographic groups.

First, I studied related literature in order to understand various ways of thinking about the benefits of flood control – formally, this lead me to the literature on methodologies for assessing *'value'* for flood prevention, including that associated with contingent valuation and *'willingness to pay'* (WTP); and that associated with *'life satisfaction'* (LS). Following this, I ran eight focus group discussions in the case study area, to determine factors that were regionally relevant to local individuals/households. Inputs from the discussion were incorporated in the pre-test survey, in which I designed my hypothetical scenario for assessment in my CV study (e.g. payment vehicle, frequency of payments, amounts in the payment cards), determined how best to phrase particular questions, and identified an appropriate data collection method. During July and August 2013, I conducted face-to-face interviews with the help of eight hired and trained enumerators in six towns and one city of the MI region, capturing the views of 600 respondents.

Prior studies that have estimated flood damages rarely include indirect and/or intangible flood damages and their focus is usually on a single flood event and/or a single year of damages. I sought to better understand flood impacts over a longer period of time, collecting data about flood damages over a five-year period. I found that the *'average'* households incurred around ₱1,800 to ₱3,700 (US$39 to US$82) worth of flood damages during that period – most damage (>60%) being associated with damage to property, the rest associated with loss of employment opportunities and other damages (e.g. medical expenses).

This gives an indication of how much damage could be avoided should floods cease to impact people in this region. It does not, however, provide an estimate of the welfare costs (and thus, economic benefit) of flood prevention because the estimate does not include a measure of the cost of *'intangibles'* (such as trauma) and does not allow for the fact that individuals are (finances permitting) able to undertake at least some private mitigation activities (such as elevating houses, or moving to less flood prone areas).

In theory, the CV method is able to get around those problems, generating more accurate estimates of the welfare costs of flooding – although there are numerous interrelated variables that affect WTP. I thus designed a flood valuation model that examines these relationships using a two-stage interval regression. I found that the *'average'* household was only willing to pay around ₱108 (US$2.4) per year to prevent any future flood impacts. Although the design of the survey and methods used to analyse data sought to minimise some of the problems commonly associated with CV (including, but not limited to survey and hypothetical bias), the WTP estimates, at less than 2% of reported damage, were much lower than expected. The big difference between WTP and reported damages could indicate that: (a) damages were grossly over reported; (b) intangible costs are negligible; (c) respondents felt that they had many opportunities to mitigate flood impacts privately; and/or; (d) that respondents were constrained by ability to pay. But the differences might also be attributable to the fact that the CV method can only generate accurate estimates of welfare costs if respondents are able to accurately predict their utility in the future – with and without flood prevention. This requires respondents to have perfect information and respond to questions about WTP truthfully and rationally.

The last method I used (the LS approach), does not require this to be so, and – like the CV method, is able to capture intangibles and also people's private ability to undertake flood mitigation activities. I used the method to estimate the *'value'* of flood prevention by using coefficients from a regression model to calculate the amount of income that would need to be paid to respondents to *'compensate'* them for losses in their level of life satisfaction associated with (self-reported) flood damages. In previous applications of the LS model, most researchers have used secondary data to capture differences in the environment (e.g. national pollution levels, flood depth within a region), which is then compared to individual-level life satisfaction scores. I addressed this potential problem of heterogeneity (whereby individuals within the region might experience different flood impacts), using self-reported damage assessments instead. I found that, on average, households would need to be compensated by around ₱1,515 (US$34) per year for reported flood damages – an amount that is approximately equal to the average annual flood damage reported.

While the LS method does not require rationality and perfect information, the method (like all valuation methods) is not problem-free: social desirability bias, context effects and endogeneity are all real and present issues.

From my results, I implied that the LS approach seems to be a better option for estimating the *'value'* for flood prevention, if and only if, endogeneity of income has minimal and/or insignificant effect on the *'income compensation'* estimate. In terms of applying the CV method to flood valuation, I find room of improvement. If my findings are applicative to other flood-vulnerable and/or urbanised areas, then the fact that individuals are unlikely to be able to predict their utilities and their level of flood risks, limits the applicability of the CV method. Improving our understanding of these important issues will present an important step forward in assessing the *'value'* of, and thus determining the *'optimal'* level of, government funded flood mitigation services – eventually enhancing the well-being of communities.

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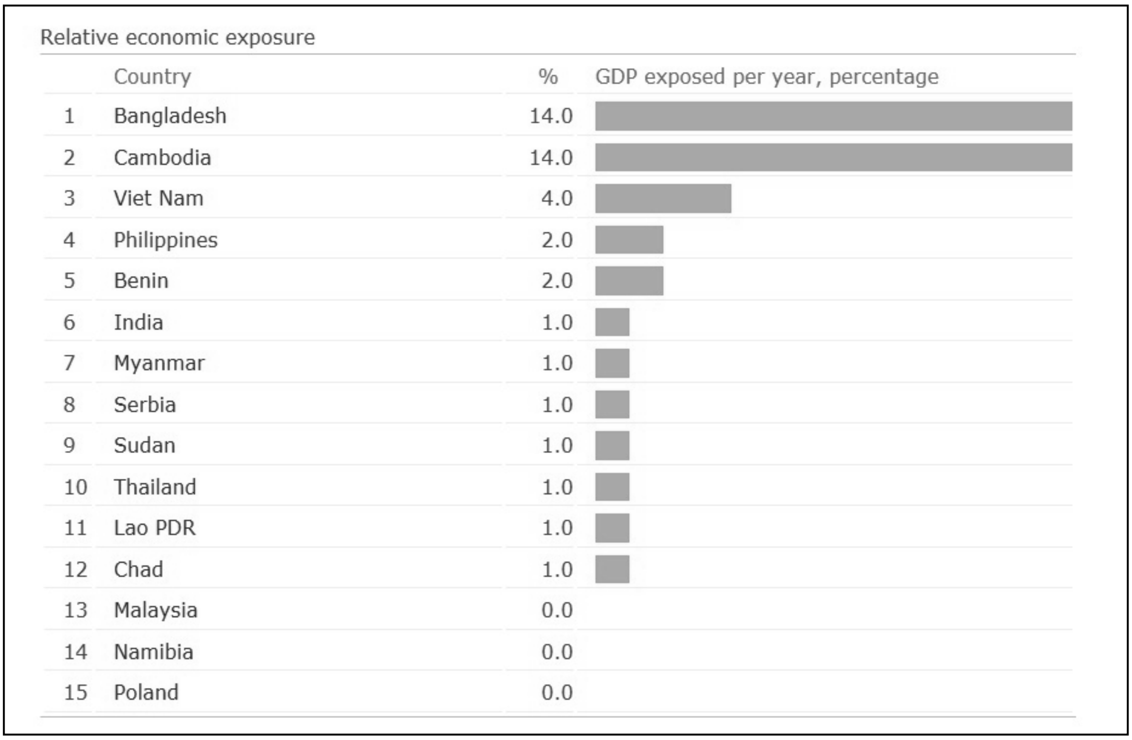
1: Introduction

Chapter outline

1.1. Floods and other disasters affect human and economic systems

Flooding is a natural phenomenon that occurs when a body of water (e.g. rivers or creeks) overflows to land that is not usually immersed (Jha, Bloch, & Lamond, 2012). Floods may be attributed to hydrological/meteorological factors, such as precipitation (Pistrika & Jonkman, 2010; De Moel & Aerts, 2011; Jongman et al., 2012) but the impact of flooding (on humans) depends, amongst other things, on social, demographic and economic factors, such as poverty and urbanisation (Wisner, Blaikie, Cannon, & Davis, 2004). Roads, houses and crops are often damaged or destroyed during floods and repair is costly. For example, the 2013 typhoon Haiyan in the Philippines is estimated to have caused at least US$830M of damage. Roughly half of that total damage was to infrastructure; the remainder was agricultural damage (NDRRMC, 2014). Floods may also cause casualties (Takumi, 2014), interruptions to transport (Felipe, 2001), power outages (The Official Gazette, 2013), health problems (Zoleta-Nantes, 2002) and loss of employment opportunities (Takumi, 2014). Families and individuals may also experience post-traumatic stress disorder (PTSD) or related emotional problems after surviving floods or other natural disasters (Gelbach, 2008).

Disasters, such as typhoons and floods, are increasingly recognised as serious and worldwide concerns – although the economic impact of floods in less affluent countries is particularly severe. As shown in Figure 1.1 the economic impact of flooding – with monetary damages expressed as a percentage of Gross Domestic Product, GDP) – are greatest in Bangladesh, Cambodia, Vietnam and the Philippines.


Relative economic exposure

	Country	%	GDP exposed per year, percentage
1	Bangladesh	14.0	
2	Cambodia	14.0	
3	Viet Nam	4.0	
4	Philippines	2.0	
5	Benin	2.0	
6	India	1.0	
7	Myanmar	1.0	
8	Serbia	1.0	
9	Sudan	1.0	
10	Thailand	1.0	
11	Lao PDR	1.0	
12	Chad	1.0	
13	Malaysia	0.0	
14	Namibia	0.0	
15	Poland	0.0	

Figure 1.1: Relative economic exposure (flood damage as a % of GDP) - Global Assessment Report (2009).

Moreover, typhoons and floods are likely to happen more often in the future and they may impact more people. According to the Intergovernmental Panel on Climate Change (IPCC, 2014), typhoons and floods are likely to occur more frequently in some parts of the world. Also the World Risk Report predicts that urbanisation will put additional strain on disaster-vulnerable areas (UNU- EHS, 2014). This is particularly problematic in megacities and coastal regions where urban populations are predicted to rise rapidly (Wisner et al., 2004; UNU- EHS, 2014) and where a large proportion of the population lives in disaster-vulnerable areas. For example, around 18% of Asians live in low-laying areas (i.e. less than 10 metres above sea levels), such as in Ho Chi Minh City, Mumbai and Jakarta.

Thus, there is likely a need for governments to further address disaster problems. However, budgets are limited and there is ongoing disagreement about the scale of spending that should be undertaken for disaster mitigation and relief. In this thesis, I focus on spending for flood prevention/mitigation, which is an important component of disaster management (details in Section 3.3).[1] This includes actions aimed at reducing flood impacts, such as the construction of structural interventions (levees or water barriers), which are known to have reduced damages from floods in Japan (Zhai, Sato, Fukuzono, Ikeda, & Yoshida, 2006), Brazil (Fuks & Chatterjee, 2008) and Indonesia (Marfai, Sekaranom, & Ward, 2015). Mitigation activities also include non-structural activities (e.g. flood insurance) (Botzen & van den Bergh, 2012; Lo, 2013; Bui & Nguyen, 2014) although it is the structural activities that are the focus of my work.

National and local governments (such as in the Philippines) do not have clear budgets for flood mitigation activities and data on their disaster expenditures (of which disaster/flood prevention is only a part) is often unavailable (Benson, 2009). Moreover, disaster funds are not always spent on disasters: the World Bank (WB) 2008 Report[2] estimated that around 50% of disaster funds were not used properly in the Philippines. In addition, local governments are sometimes only able to access disaster funds if their region is declared '*under the state of calamity'* (Gaillard, Pangilinan, Cadag, & Le Masson, 2008). In instances where disaster-related programs

[1] In this thesis, the terms *'prevention'* and *'mitigation'* are used interchangeably.
[2] As cited in Lasco and Delfino (2010)

exist, funding often relies on external sources (Yu-Tzu, 2013) and budgets are frequently deemed insufficient (Benson, 2009). For example, public shelters are costly to erect (estimated at approximately US$5,000 per shelter) and budgets are too small to provide an adequate number of shelters for all disaster-affected households in Bangladesh (Wisner et al., 2004). Given these constraints, this thesis provides an important opportunity to understand more about whether investments in flood strategies (particularly flood prevention/mitigation) are worthy.

Despite the fact that much research has been undertaken on flood prevention in developed countries, findings from developed countries may not be generalisable to poorer nations. That is, difficulties may arise when attempts are made to implement policies from other regions without fully understanding *'local'* public preferences for flood prevention projects (Zhai, Sato, Fukuzono, Ikeda, & Yoshida, 2006; Seidl & Stauffacher, 2013). Hence, there is an imminent need for research that generates information, which can guide policy makers when making decisions about expenditure for flood mitigation activities, in flood-prone, less affluent countries. This is, therefore, the focus of this thesis.

1.2. Flood prevention is a public good

Goods, which prevent floods (such as structural interventions – levee banks), have non-rivalry and non-excludability characteristics, which are attributes of a public good. Non-rivalry relates to a situation in which one person's use of a good does not come at the expense of other people (they can also use it – unlike for example, food where consumption by one person leaves less for other people to eat). Non-excludability refers to a situation in which it is not possible to prevent anyone from benefiting from a good once it is produced. If a levee bank is erected to protect just one resident from floods, other residents will also be protected, even if they have not paid (e.g. this is relevant to poor residents who are not paying taxes).

Competitive markets may provide an efficient allocation of private goods, but will not do so for public goods. Thus, it may likely fall to government to help redress this market failure. To illustrate how the market for flood prevention fails, a diagram developed by Agthe, Billings, and Ince (2000) is useful (Figure 1.2). Assuming two households with individual demand curves, AB and CD; the market demand curve (summation of demands of these two individuals), EFD (assuming flood prevention is a private good); and the market supply curve, OJ. The optimal level of flood prevention is at P units at price Z, where the market demand intersects market supply. However, this market will fail because of the free-riding problem. If the first household will purchase flood prevention first, it will be willing to purchase OM, while the second household will only buy the additional units, MN. On the other hand, if the second household will choose to purchase flood prevention first, it will purchase ON. At this level, the first household will not pay anything, thus, free-ride the benefits from flood prevention paid by the first household. The efficient amount of flood prevention/mitigation (OP) will not be provided.

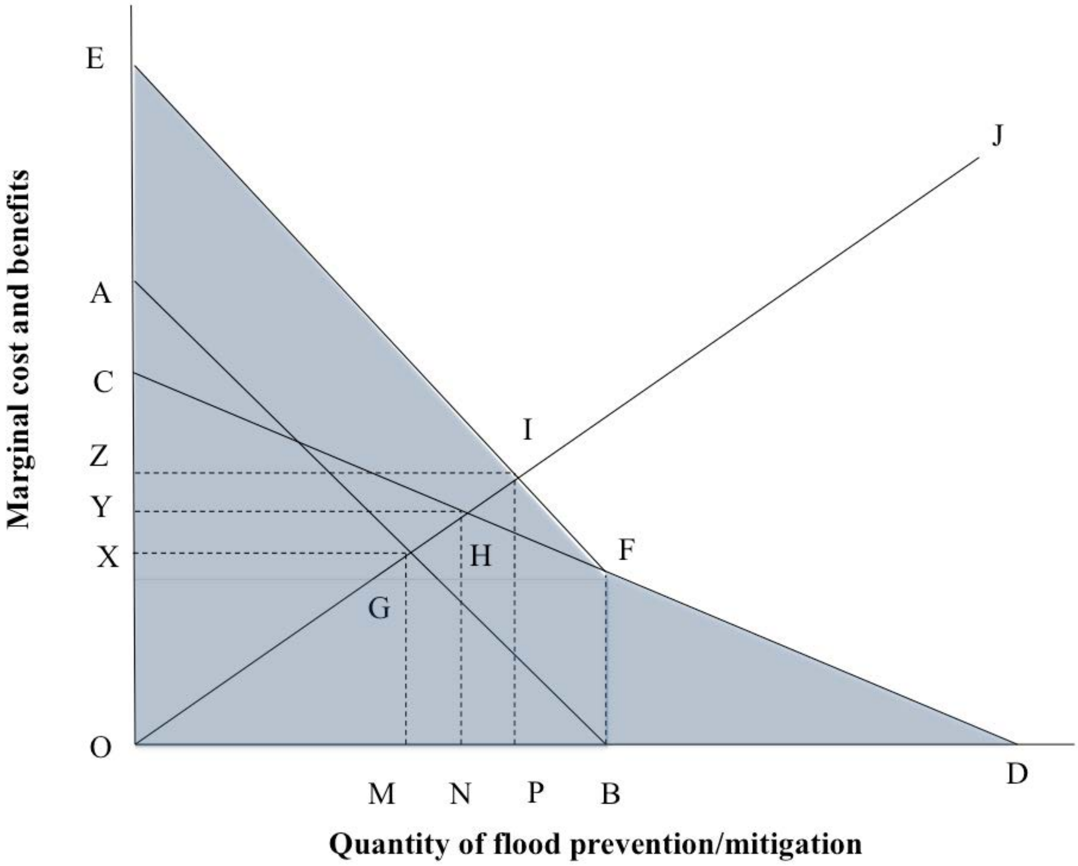


Figure 1.2: Optimal and upper-bound flood prevention spending.

Aside from being a public good, the market for flood prevention is also likely to fail because of imperfect information. Markets fail when buyers lack information about a particular product (e.g. its quality or other attributes). Akerlof (1970) presented this case using automobiles, where he argued that when information is inadequate and/or unobserved by consumers, they expect producers to *'skimp'* on quality of automobiles. As a consequence, their willingness to pay is low. Market fails as consumers may be unwilling to pay for automobiles about which they have insufficient information. In their study of the National Flood Insurance Program (NFIP) in the USA, Chivers and Flores (2002) found that *"lack of knowledge of flood risk and lack of knowledge of the cost of insuring against flood risk"* contributed to market failure (p. 520).

As such, the public good nature construct (such as levee banks), imperfect information associated with floods, (possible) free-riding problem, suggest that the market may not provide the *'optimal'* levels of flood protection.[3] Hence, a core question for policy that is addressed in this thesis is: *how much should be spent on flood prevention?*

Since this thesis focuses on demand for flood prevention; not the (marginal) cost of flood prevention, I will not be able to determine the optimal amount of spending on flood prevention. The thesis will explore how much residents in a flood prone area are willing to pay for flood prevention/mitigation. This is shown as the total willingness to pay, which is equivalent to the area under the market demand curve EFD, shown in blue colour.

This research demonstrates the use of three different ways of seeking to inform that question. It uses data collected from a flood-prone less affluent country (the Philippines), to generate estimates of:

1) The average annual flood damage borne by households. This is an estimate of the damage that could be avoided, if flood mitigation expenditures ensured zero flood damage;
2) Resident willingness to pay to avoid all future flood damage. This is estimated using the contingent valuation (hereafter, CV) method; and

[3] *'Third parties'* such as non-government organisations may provide public goods and improve social welfare. In the case of flood prevention, third parties have actively participated in community-level flood prevention (Luna, 2001; Gaillard & Cadag, 2009), such as sand bagging, but these mitigation measures are (successfully) implemented by international NGOs as costs of these programs are very high (Luna, 2001). My thesis focuses on the government in the provision of these goods.

3) The amount of income that would need to be paid to residents to *'compensate'* them for flood damage – i.e. to keep life satisfaction constant (hereafter, LS). This is estimated using the LS approach.

It compares and contrasts the estimates derived from each of these methods. It uses insights from the investigation to provide empirically relevant information (about flood damage in the Philippines) while gleaning important methodological insights about the use of these non-market valuations in less affluent countries.

The rest of the thesis is structured as follows:

Chapter 2 discusses the literature relating to flood damage estimation, the CV and the LS approaches that are used to summarise research gaps, and identifies the specific research aims of this thesis.

Chapter 3 describes my case study country (the Philippines), particularly looking at its economy and development for the past years as well as its experience with typhoons/floods. The chapter also discusses the government's expenditure on flood impact prevention. Moreover, it also describes the study area [Metropolitan Iloilo (hereafter, MI) in the central Philippines] and explains why it is an appropriate case study area. Here, I emphasise imminent threats and worsening impacts from typhoons/floods as well as the diverse industries and socio-demographic characteristics of households in the study area.

Chapter 4 outlines the methodological process I implemented, which includes using insights from the literature and from focus-group discussions (FGDs) to develop a survey/questionnaire. It also describes the pre-test and main household survey.

Additionally, descriptive statistics of relevant variables used in this thesis are shown and discussed in this chapter.

The purpose of **Chapter 5** is to describe how I used household survey data to estimate flood damages. The chapter presents data as the long-term monetary and non-monetary impacts of floods on households.

Chapter 6 discusses the WTP for flood prevention using the CV method. This attempt is quite novel, in the sense that the model explores the possibility of multiple interacting relationships between factors. The investigation used a two-stage regression, where the first regression is a negative binomial regression for flood damage while the second regression is an interval regression for WTP.

Chapter 7 focuses on the life satisfaction (LS) approach. What is unique about this chapter is the inclusion of relative flood damages (relative to flood damage incurred by residents in the neighbourhood), which has never been explored in the LS literature. It also includes a discussion of what drives high overall life satisfaction of Filipinos.

The summary of findings is described in **Chapter 8**. It consolidates the results from Chapters 5, 6 and 7 and draws out significant arguments relating to the validity and practical use of these valuation techniques. I specifically argue that all of the techniques have their own strengths and weaknesses, but it seems that the LS approach has generated more reliable estimates and may be a more practical application compared to the damage assessment and CV method. Directions for future research are also outlined in this chapter.

Thesis outline

CHAPTER 1
Thesis introduction

CHAPTER 2
Related literature, research gaps, research aims and hypotheses

CHAPTER 3
The Philippines and the Metropolitan Iloilo

CHAPTER 4
General methodology and description of sample population

CHAPTER 5
Determining the *'value'* of flood prevention using flood damage assessment

CHAPTER 6
Assessing willingness to pay (WTP) for flood prevention

CHAPTER 7
Valuing flood damages using individual life satisfaction data

CHAPTER 8
Summary, contribution of thesis and future research

2: Related literature, research gaps, research aims and hypotheses

Chapter outline

In Chapter 1, I explained that floods affect economies in various ways in both less affluent and developed economies. Governments around the world have developed programs that attempt to mitigate these impacts. Spending on policies that minimise these impacts, however, becomes an issue because budgets for managing floods are mostly constrained/limited, deemed low priority, or misdirected (Benson, 2009), particularly in poor and/or less affluent countries. From these arguments, I deduce that policy success in disasters requires that governments have an improved understanding of how floods affect social welfare, so they can make more informed judgements about budgets for flood prevention programs (e.g. to inform decisions about how much to spend on these programs). This will become increasingly important because flood impacts are likely to worsen in the future due to climate change and rapid economic growth.

Economists play a crucial role in providing information to inform and/or advise decisions about flood prevention spending, especially as there are numerous methods for measuring the *'value'* of flood prevention activities (e.g. the construction of levee banks). This chapter discusses literature relating to three of these tools and comprises five sections. The first (Section 2.1) discusses flood damages in general, highlighting the difficulties confronting empirical researchers who wish to generate monetary estimates of the *'value'* of those damages. The next three sections each focus on a single *'valuation'* method: the flood damage assessment (Section 2.2); contingent valuation (CV) (Section 2.3); and the life satisfaction (LS) approach (Section 2.4). Each section discusses previous research undertaken using these techniques (with a particular focus on flood prevention) and highlights research gaps. These gaps are used to identify specific objectives and to formulate hypotheses for testing in subsequent chapters. The last section summarises key insights from this chapter.

2.1. Introduction: flood damages are complex

Economic theory suggests that if the marginal benefit (MB) of an activity is greater than the marginal cost (MC), then the activity should be undertaken. But it is difficult to assess the benefits of preventing flood because the damages from floods are numerous, varied and not all damages relate to the market. I discuss flood damages in this section.

A large volume of published studies describe various damages from floods. Messner and Meyer (2006) succinctly defined flood damage as *"all varieties of harm caused by flooding"* (p. 150). Flood damages may be measured directly or indirectly and can be tangible or intangible (Table 2.1).

Table 2.1: Types of flood damages.

Types of damages	**Examples**
Direct, tangible	Damage to private buildings and contents; destruction of infrastructure such as roads, railroads; erosion of agricultural soil; destruction of harvest; damage to livestock; evacuation and rescue measures; business interruption inside the flooded area; cleanup costs.
Direct, intangible	Loss of life; injuries; loss of memorabilia; psychological distress, damage to cultural heritage; negative effects on ecosystems.
Indirect, tangible	Disruption of public services outside the flooded area; induced production losses to companies outside the flooded area (e.g. suppliers of flooded companies); cost of traffic disruption; loss of tax revenue due to migration of companies in the aftermath of floods.
Indirect, intangible	Trauma; loss of trust in authorities.

Source: (Merz, Kreibich, Schwarze, & Thieken, 2010, p.1699).

Direct damages refer to direct costs from floods such as damages to residential properties, public infrastructure, crops etc. (van der Veen, 2004; Merz et al., 2010).[4] Indirect damages refer to costs from interruptions to business and multiplier effects felt elsewhere in the economy including in other industries due to floods (Parker,

[4] Flood damage models often use hydrological data (e.g. rainfall volume) and predict flood characteristics (e.g. speed/velocity) such as in Pistrika and Jonkman (2010), De Moel and Aerts (2011) and Jongman *et al*. (2012) and I recognise that these assessments contribute to the flood damage assessment literature but hydrological data is not the focus of my thesis.

Green, & Thompson, 1987). They are *"results of dislocations suffered by economic sectors not sustaining direct damage. Activities that are either forward-linked (rely on regional markets for their output) or backward-linked (rely on regional sources of supply) could experience interruptions in their operations"* (Cochrane, 1997, p. 225).

When examining damages at a macro (national) and/or meso (regional) level, the extent of indirect damages will depend on numerous factors such as the availability of substitute sources of supply and demand; the period of the flood interruption (ranging from hours to days); and the possibility to lengthen production (van der Veen, 2004). For instance, raw materials and infrastructure destroyed during floods may have an indirect impact on production as businesses may need to use alternative and expensive inputs to continue production.

Merz et al. (2010) notes that indirect damages may also vary across sectors because of differences in assets and flood risk levels. There is high variability in these for the service and industry/manufacturing sectors compared to private households. In Smith's (1981) assessment of urban flood damages in Lismore, New South Wales (NSW) in Australia, the commercial sector had the most actual and potential damages followed by the industrial and the residential sectors.

Floods can also cause direct and indirect damages to households and individuals. The National Flood Insurance Program (NFIP) in the United States has an interactive calculator for direct household damages, where total damages are calculated by looking at how large the house and how deep the floodwater is that came into the house (NFIP, 2015). In here, the direct and tangible damages include cleaning costs, electrical/plumbing repair, furniture damage, or loss of personal items. Direct and intangible damages include injury during floods that may be measured by looking at medicine and/or hospital expenses (Bowers & Young, 2000). Loss of earnings/income and loss of productive assets are also often included when assessing flood damages, the latter assessed as a salary/wage equivalent.

Many studies have estimated the direct and tangible damages that could be avoided; but it is much more difficult to measure intangible damages. This is partly because intangible costs do not have easily observable market values (e.g. loss of leisure, a sense of place, historic monuments/cultural assets). So it is difficult to include them in damage assessments (Cochrane, 2004).

Table 2.2 provides a few examples of investigations that have assessed flood damages, including those that look at willingness to pay (hereafter, WTP) for reducing flood damages (to be discussed more in Section 2.3). Some researchers used reported estimates of monetary damage but such information is not always available. In these instances, proxies are often used. In their studies on demand for reducing flood risk Zhai et al. (2006) and Ghanbarpour and Saravi (2014), used physically observable variables such as distance to nearest rivers as a proxy for flood damage. I will discuss more demand studies and their assessment of flood damages in Section 2.3.

Some studies have focused on loss of life or health effects (Landefeld & Seskin, 1992; Hanley & Spash, 1993; Sendi, Gafni & Birch, 2002). A few attempts have also been made to include psychological impacts from flood. In the United Kingdom (UK), the Department for Environment, Food and Rural Affair (DEFRA) is responsible for flood damage assessments. They estimate both direct damages and health effects from flooding. Several surveys on health well-being were integrated to provide understanding of flood impacts, such as the General Health Questionnaire-12 (GHQ-12), Impacts of Events Scales (IES), Post-Traumatic Stress Scale (PTSS). In addition, surveys have included questions relating to *"three categories of health effects that they or other members of their household might have experienced: (1) physical health effects during or immediately after flooding; (2) physical health effects in the weeks or months after the flooding; and (3) psychological health*" (DEFRA, 2005, p. 54).

Table 2.2: Selected economic studies that looked at flood damages.

Related studies	**Flood damage data/proxy used**
Zhai et al. (2006)	Willingness to pay for flood prevention; flood experience (yes or no) and distance to rivers
Fuks and Chatterjee (2008)	Willingness to pay for structural flood prevention; flood water height/depth as proxies of impacts
Brouwer, Akter, Brander and Haque (2009)	Willingness to pay reducing flood risk; reported monetary impact to various categories (e.g. loss of crops, medical treatment, damage to houses etc.)
Navrud, Tran and Bui (2012)	Willingness to contribute for a flood program; physical damages such as loss of their house, crops and livestock
Botzen and van den Bergh (2012)	Building and home contents
Lantz, Trenholm, Wilson and William (2012)	Government flood damages – secondary data of (1) landscaping (trail clean up and restoration and river-front clean-up), (2) prevention (water barricades and water pumping), (3) transportation (roadway clean-up), (4) emergency service (police and fire department services) and (5) citizen evacuation expenses (lodging and meals). Business sector - Self-reported damages in: property damage, lost productive time, preventative expenditures, additional operating costs, etc. for each (flood) zone. Households – Self-reported, damage/repair costs to their buildings, landscapes and personal items; costs of any preventative measures taken prior or post flood; the cost of lost work time; temporary displacement costs; medical costs; etc.

Related studies	Flood damage data/proxy used
Bin and Landry (2013)	Flood exposure (households in floodplain areas or not)
Ghanbarpour and Saravi (2014)	Distance to the river and flood exposure (households in floodplain areas or not)
Wijayanti, Tono, Hastuti and Pramudita, 2015)	Damages to households and businesses - floodwater depth and duration of floods

These types of impacts are often studied in the public health literature and are reported by governments. For example, Azad, Hossain and Nasreen (2013) trace the vulnerabilities from floods and identify that Bangladeshi women experienced physical, sexual and verbal abuses that oftentimes happened in relief or shelter centres. Psychological consequences of Kosi River flooding in India were investigated and found that Indian women had more difficulty in adjusting to flood disasters than men because of lack of available social activities (Crabtree, 2013). In addition to the DEFRA studies mentioned in the previous paragraph, incidences of illnesses and other health-related concerns were documented [e.g. Public Health Office in Chiang Mai in Thailand record incidences (Jarungrattanapong & Manasboonphem, 2011)], but reports studying psychological effects at government levels are rare.

Non-monetary impacts, particularly those involving emotions also demonstrate lingering effects. In Crabtree's study (2013), he found that the majority of people affected by flood have showed symptoms of depression and PTSD more than a year after a flood disaster. In a similar investigation, Smith, Davies-Colley and Mackay (2011) provided evidence that post-event stress is prevalent in flood victims in New Zealand, where some reported recurring sleeping problems and anxiety.

Importantly, the scale of analysis needs to be considered. Cochrane (2004) noted that when assessing disasters (including floods), researchers often focus on individuals, households, industries or regions. They also focus on groups considered to be *'vulnerable'* such as the poor and/or subsistence farmers and/or those without insurance to cover damages (Cochrane, 2004; Benson, 2009). Little is known about the overall (flood) damage suffered by households with varying socio-demographic statuses; which may include the indirect/intangible damages discussed previously that are equally important in damage assessments. Because of a lack of fine-scale (individual or household) data, researchers often use data that applies to one scale (e.g. average flood depth in region A) to draw inferences about impacts at another scale (e.g. flood damage in an individual house). In these instances, unobserved heterogeneity may bias estimates of flood damage (or of WTP to prevent damage) since flood impacts will likely differ across households or between towns.

Assessment of flood damages, using market prices, may be also challenging, because of depreciation (or the decline of value of an asset). This is particularly true in damages relating to investments and physical assets (van der Veen, 2004; Merz et al., 2010). For instance, using current market price of a damaged and old car as part of the damage to personal property, is an overestimation of damages from floods.

In summary, assessment of flood damage is complex as it includes not only direct/indirect costs but also those that are tangible/intangible. These damages impact many people and different sectors (e.g. individuals, households and governments). Previous studies highlight that measurement of these damages is not an easy task. Some methods only incorporate direct and tangible costs (e.g. damage to houses, crops, etc.); while some include indirect damages (e.g. I/O or CGE models). There are also some methods that use hypothetical markets (e.g. contingent valuation) to help capture intangibles.

Since a full discussion and inclusion of all measurement problems relating to flood damage is beyond the scope of a single thesis, I focus on just a few, in particular:

- Damages to households – primarily the monetary/tangible damages, but also some intangibles (Section 2.2);
- People's WTP to avoid the damages they have experienced from floods (covers both tangible and intangible) (Section 2.3); and
- The extent to which flood damages impact an individual's stated LS (covers both tangible and intangible) (Section 2.4).

2.2. Assessing direct flood damages to households

2.2.1. Research gaps relating to (flood) damage assessment

Simplistically, a routine flood damage assessment generates an estimate of the *'value'* of flood prevention by determining how much damage is generated by floods – this provides an estimate of the damage that could be avoided by, for example, erecting levee banks which prevent all future floods (assuming, of course, that future flood patterns and damages mimic the flood patterns and damages used to generate estimates). The approach is heuristic and usually involves relatively few research steps/activities and requires relatively few data resources (Notaro & Paletto, 2012).

The (relative) ease of use is attributable to the fact that the approach uses observable data from markets, which are easily obtained from secondary sources. Moreover, data relating to flood damages or to the characteristics of flood (e.g. depth, duration, velocity, etc.) may also be readily available from government or other institutions. As such, estimates can be generated quickly (Notaro & Paletto, 2012); which makes the approach a popular choice for policy makers in project appraisals (Turner, Pearce, & Bateman, 1994).

Normally, it is only tangible damages (that are easily assessed in monetary terms) which are included in these assessments and there are comprehensive guidelines for measuring damages to personal/residential properties, commercial/retail industries and other properties (Penning-Rowsell & Chatterton, 1997). As discussed in Section 2.1, flooding also generate intangible damages such as those associated with stress and mental illness (such as PTSD), but these intangibles are not generally associated with the market, are thus difficult to monetise and usually omitted from these market-focused analyses (to monetise intangibles, one needs to use other techniques such as CV or LS as discussed later in this chapter).

The majority of damage-cost evaluations have focused on a single (disastrous) flood event (van der Veen, 2004; Benson, 2009). These one-off assessments thus fail to generate estimates of the *'average'* flood damages incurred by households over long periods of time. Moreover, they do not capture the long-term effects of floods on households or the effect of recurrent flood events. There is thus a gap in our understanding of the impact of floods over time – including, for example, years in which there are no floods. Neither do they allow for the impact of recurring (perhaps even small/less disastrous) floods as well as of damages from catastrophic events.

2.2.2. Objectives

The first objective of this thesis is thus to:

General objective #1: Determine how much damage (to households) could be avoided if one were able to prevent floods;

Specifically, I aim to:

1) Collect household level data on actual flood damage from a five-year period; and
2) Collect and estimate flood damages in different damage categories (e.g. property damages and employment losses) and across households with different socio-demographic characteristics.

Meeting this objective will allow me to make two important contributions: one empirical (estimates of household damages that could have been avoided with appropriate flood prevention strategies) and one methodological (looking at (a) various damage categories, (b) a fixed calendar time period, rather than a short period covering a single flood event and (c) households with different socio-demographic backgrounds).

2.2.3. Potential problems with flood damage estimation

A question that needs to be considered, however, is whether those estimates are likely to be a *'true'* measure of the welfare cost of floods. At least three concerns exist.

First, the measures of welfare costs will be incorrect, if households do not provide an accurate estimate of flood damages. When asked about damages from flood, people may not accurately recall past damages. Moreover, respondents – particularly those suffering recent trauma – may not accurately report true damages either for strategic reasons (e.g. trying to elicit sympathy, which could inflate damage estimates) or for reasons associated with social desirability bias (Krumpal, 2013).[5]

Second, as discussed in the earlier sections, and related to the point above, floods do not only inflict tangible damages: intangible damages, such as PTSD or emotional strain are common and may have a lingering effect on disaster/flood victims (Smith et al., 2011; Crabtree, 2013). Market-based methods, which rely on observable prices/costs to generate estimates of the *'value'* of flood prevention, thus omit intangibles. *'Values'* derived from the flood assessment will thus be only partial or incomplete (Farber, Costanza, & Wilson, 2002). This omission will tend to generate a downward bias in estimates (i.e. flood damage estimates that neglect these impacts will *understate* true impacts).

Third, individuals have *some* control over flood impacts. If floods regularly impact individuals, they may undertake actions (finances permitting) to avoid or mitigate future flood impacts (e.g. moving away to a less flood-prone area or attempting to raise house on *'stilts'*). Thus, in managing flood risk, individuals are sometimes able to adopt several different strategies (Botzen, Aerts, & van den Bergh, 2009). According to the researchers from the Environmental Research Hub, *'5.1 million people per decade migrated away from the highest-risk drought areas'* (Environmental Research Web, 2013). If the government were to fully compensate households for reported flood damages, then households would have no private incentive to undertake personal actions to mitigate flood impacts. As such, we expect

[5] Social desirability bias occurs when individuals agree with questions being asked in the survey, regardless of their true beliefs/opinions. In this case, they believed that the interviewer might be offended (Podsakoff, MacKenzie, & Podsakoff, 2012).

estimates of flood damages to over-estimate the *'true'* welfare costs of flood (even if these reports were accurate).

That some of the biases discussed above will tend to mean that flood damage estimates understate *'true'* welfare costs while others mean that flood damage estimates will overestimate welfare costs underscores the importance of using other valuation techniques – as discussed next.

2.3. Assessing household willingness to pay (WTP) to avoid direct flood damages

The CV method and other non-market valuation approaches place monetary values on market and non-market goods (Daly & Farley, 2004) – so they can account for both the tangible and intangible impacts of floods. In other words, they can, in principle, estimate the *'true'* welfare impact of changes in the availability of non-market goods and services (Dolan & White, 2007), such as flood mitigation activities (e.g. construction of a levee bank). Formally, the monetary value of non-priced goods/services can be estimated by calculating the monetary equivalent of the impact of changes in their availability on utility (McFadden & Leonard, 1993; Fujiwara & Campbell, 2011); wherein changes in utility are calculated using the indirect utility function:

$$v(p_0, Q_1, y_0) = v(p_0, Q_0, y_0 + \delta) \qquad \textit{Equation 1.}$$

$$v(p_0, Q_2, y_0) = v(p_0, Q_0, y_0 - \lambda) \qquad \textit{Equation 2.}$$

where

p_0 is the price level for market goods,

Q_0 and Q_1 are the old and new level of good/service, respectively (e.g. flood prevention),

y_0 is income, δ is the willingness to pay (WTP), and

λ is the willingness to accept (WTA).

Either WTP or WTA estimates can be derived from the CV method. The former estimates the maximum amount an individual is willing to pay in order to consume Q_1 (instead of Q_0: with $Q_1 > Q_0$); while the latter refers to the minimum amount an individual is willing to receive as a compensation for consuming Q_2 (instead of Q_0: with $Q_2 < Q_0$). In relation to flood management, Q_1 may refer to a policy involving more expenditure on flood prevention (*'how much are you willing to pay for preventing flood damages'*) while Q_2 may refer to a situation where individuals are likely to experience more flood damages (*'how much are you willing to accept for being flooded more frequently'*).

The CV method assumes rationality as stated in the Axioms of Revealed Preferences,[6] and that individuals can successfully predict their utility and therefore seek to maximise their utility subject to a budget constraint and to other factors (such as flood damages and perceptions/attitudes). This has important implications when applying CV in situations where imperfect information (discussed in Section 2.3.1) is likely to prevail since imperfect information will preclude individuals from accurately

[6] Fujiwara and Campbell (2011, p. 10) summarises these axioms: (1) complete – individuals are able to express a preference for any good or say they are indifferent between any pair of goods; (2) transitive – individuals who prefer (or are indifferent to) good *x* over good *y* and who prefer (or are indifferent to) good *y* over good *z*, must also prefer (or be indifferent to) *x* over *z*; and (3) reflexive – individuals are indifferent between *x* and *x*.

predicting utility. I will return to this important point in Section 2.3.4 and later in the thesis.

In order to capture all the tangible and intangible benefits of flood prevention, the CV method must construct and present a hypothetical market for flood damage prevention and then ask respondents about their WTA or WTP (Russel, 2001). The scenario should include the following: a detailed description of the good (e.g. levee banks) including information about how it will be provided (e.g. government or private institution); the method used to collect payments (e.g. donation through tax levies); and the frequency of payment (e.g. yearly).

The elicitation format of the CV question may be open-ended (e.g. asking directly for stated WTP or referendum), or closed-ended [e.g. using bid prices or intervals, dichotomous choices (i.e. *'yes'* or *'no'*)] (McFadden & Leonard, 1993). Also in implementing CV surveys, researchers should gather information on respondents' characteristics (e.g. age and gender), attitudes towards the non-market goods (e.g. '*I don't mind the floods'*) as well as their reasons for their preferences (e.g. *'I do not believe I am at risk of being flooded'*), so that these other factors known to also influence WTP can be controlled for when analysing data.

Aside from estimating indirect and/or intangible costs, the CV method accommodates the possibility that individuals undertake private flood prevention activities, unlike the damage assessment method. Since households will not be willing to pay the government (or others) to undertake expensive public flood prevention actions, if they can undertake cheaper private activities instead.

The CV method is a widely-used and well-tested valuation technique (Turner et al., 1994; Bateman, et al., 2002; Carson, Flores, & Meade, 2001) that has been used in both developed and less affluent economies (Whittington, 2010) and when assessing the *'value'* of numerous and different non-priced goods and services (OECD, 2002).

However, the validity of the CV depends, amongst others, on the validity of the hypothetical scenario, data collection, analysis, etc. as well as on the interrelated determinants of WTP (e.g. flood damages and household characteristics). Next, I will discuss the literature relating to flood valuation that will help minimise bias in my application of the CV method.

2.3.1. The hypothesised flood valuation framework

In the late 1980s, Thunberg, in his pioneering works on flood valuation in Roanoke, Virginia, United States (1988, 1991) estimated WTP for reducing flood risk. This led to successive inquiries, particularly on the demand for structural flood protection (Zhai et al., 2006; Fuks & Chatterjee, 2008; Botzen et al., 2009); flood insurance (Botzen & van den Bergh, 2012; Bui & Nguyen, 2014); and river/natural resource protection for preventing flood (Marzetti & Brandolini, 2012; Crastes, et al., 2014; Veronesi, Chawla, Maurer, & Lienert, 2014). Table 2.3 summarises some key flood valuation studies.

Table 2.3: Selected studies on flood valuation.

Flood valuation study	Location	Method and elicitation format	Willingness to pay (WTP) scenario	Analysis used and estimated value(s)
Zhai et al. (2006)	Toki City and Kita wards, Nagoya City, Japan	Contingent valuation; Payment card	WTP for structures (dams and levees) and non-structures (early warning signals) and for protection against floods of different levels	Tobit model; Marginal WTP for flood risk reduction beyond a *'one in a 500 years flood'* is ¥0.
Fuks and Chatterjee (2008)	Rio Janeiro, Brazil	Contingent valuation; Dichotomous choice	WTP for infrastructure costs of an anti-flood project (Iguacu flood control project)	Binary logistic model; Mean WTP approximately 1.6% of the median income
Zhai and Suzuki (2008)	Tianjin, China	Choice experiment	WTP for program in natural disaster reduction	Conditional logit model, multinomial logit mode and random parameter logit model; Total WTP RMB0.98-2.75B
Brouwer et al. (2009)	Homna, Bangladesh	Contingent valuation; Dichotomous choice	WTP for flood protection scheme in Homna	Log-logistic model and Turnbull estimation; Median WTP BDTK37.6 (US$6) and mean WTP BDTK 27 (US$4.3)
Botzen et al. (2009)	the Netherlands	Contingent valuation; Dichotomous choice	WTP for flood mitigation through using sandbags	Probit model; If there is government compensation for flood, the probability of owner to buy sandbags is around 0.09
Glenk and Fischer (2010)	Scotland, the United Kingdom (UK)	Contingent valuation; Randomised card sorting procedure	WTP for reducing flood risk	Spike model; Mean WTP £ 41.4 to £45 per household per year
Marzetti and Brandolini (2012)	Venice, Italy	Contingent valuation; Dichotomous choice	WTP for conserving historical and cultural heritage of Venice through a flood and coastal defence program	Probit and ordinary least square; Mean WTP (2002) €3.08 and mean WTP (indexed 2010) €3.70
Navrud et al. (2012)	Quang Nam province, Vietnam	Contingent valuation; Dichotomous choice and open-ended follow-up question	Willingness to contribute (WTC) labour to flood prevention program	Tobit model; Mean WTC 6.73 person days per year
Botzen and van den Bergh (2012)	the Netherlands	Choice experiment; Payment card	WTP for flood insurance	Tobit model; Mean WTP €21 per month
Lantz et al.	Fredericton,	Contingent	Willingness to	Logistic model; For *'normal'* climate

Flood valuation study	Location	Method and elicitation format	Willingness to pay (WTP) scenario	Analysis used and estimated value(s)
(2012)	Eastern Canada	valuation; Open-ended format	accept (WTA) compensation for all damages incurred from 2005 flood and WTA for damages if household experience flood water 1 metre higher than the 2005 flood	annual costs: $743,000 (market), $365,400 (non-market) and $1,108,400 (total costs)
Lo (2013)	Australia	Contingent valuation; Open-ended format	WTP for flood insurance	Probit model; Mean WTP AU$621.02 per insurance cover
Markantonis, Meyer and Lienhoop (2013)	Greece	Contingent valuation; Payment card	WTP for avoiding floods in the Evros River	Mean statistics; Mean WTP €52.27 per year
Botzen, Aerts and van den Bergh (2013)	the Netherlands	Contingent valuation; Dichotomous choice	WTP for investing house elevation	52% of residents willing to elevate their house for €10,000
Bin and Landry (2013)	North Carolina, U.S.A.	Hedonic Price	Marginal WTP for flood risk	Maximum Likelihood (MLE), Difference-in-differences (DND) hedonic property price analysis; Various estimates: e.g. US$-8742.90 for all flood risk
Ghanbarpour and Saravi (2014)	Neka River Basin, Iran	Contingent valuation; Open-ended format	WTP for flood insurance and WTP structural flood control measures	Regression analysis; Maximum WTP for flood insurance US$40 per year and maximum WTP for structural flood control measure US$49.5
Bui and Nguyen (2014)	Da Nang City, Vietnam	Choice experiment; Discrete	WTP for flood insurance	Conditional logit model; VN$14,156 per household per month for the designed premium in order to accept: rainfall: 1500–2000 mm; a river level: 4.75–5.00m; and a wind level typhoon level 6–8, VN$10,511 per household per month for all weather indices were offered by the insurance contract of around VN$ 127,000 per household per year and VN$7,603 per household per month to accept a return period of once every five years (lowest period at around VN$90,000 per household per year
Veronesi et al. (2014)	Switzerland	Choice experiment; Discrete	WTP for minimising ecological and health risk (including wastewater	Mixed logit model; Mean WTP cellar flooding CHF138.804 per year and mean WTP for street flood CHF425.890 per year

Flood valuation study	Location	Method and elicitation format	Willingness to pay (WTP) scenario	Analysis used and estimated value(s)
			flood)	
Crastes et al. (2014)	France	Choice experiment; Discrete	WTP for reducing erosive run-offs (including floods)	Random parameter logit; Mean WTP for good farming practices €12.92, mean WTP for implementation for protective infrastructure €16.09, mean WTP for improvement in communicating about erosive run-off events €5.40 and mean WTP for fully integrated management system €45.83

Using insights from these (and other related) studies, I conceptualised a general flood valuation framework (Figure 2.1) that identifies different factors that are likely to influence an individual's WTP for flood prevention. The conceptualisation involved four steps, which are explained in more detail below.

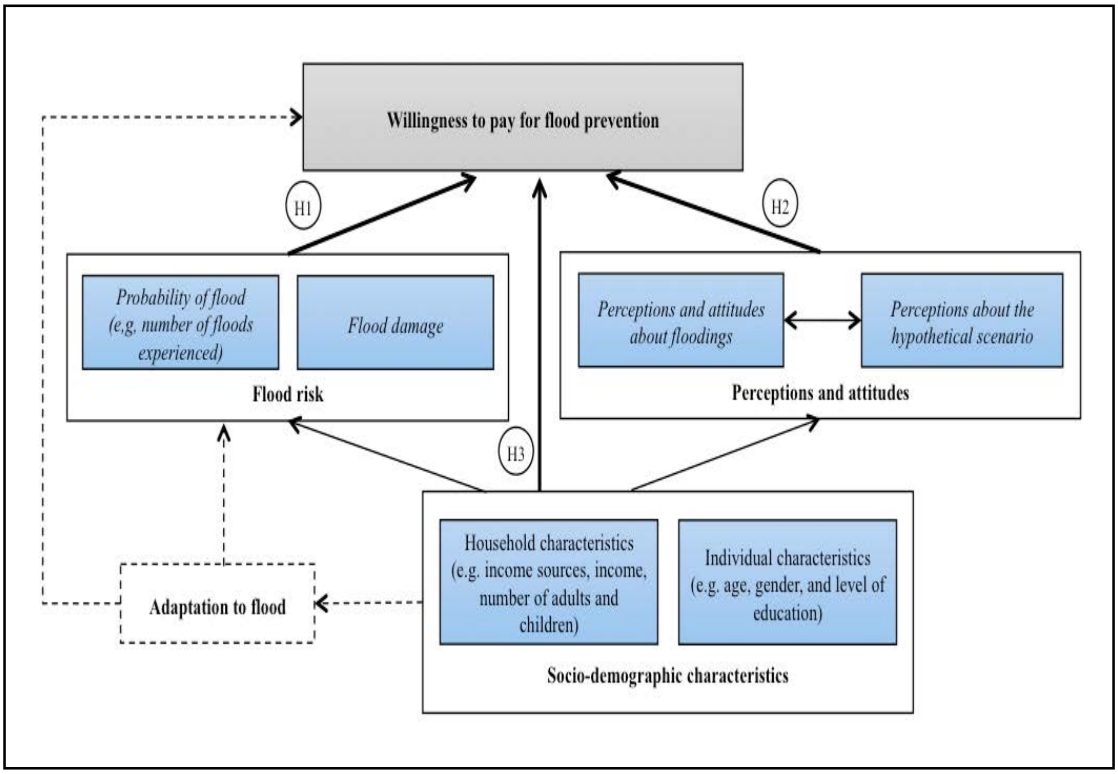


Figure 2.1: Hypothesised flood valuation model.

First, I reviewed studies including the seminal disaster/flood studies of Clark et al. (1998), Cutter, Boruff and Shirley (2003), Hufschmidt (2011), and Kellens, Terpstra and De Maeyer (2013) - all of which identify determinants of vulnerability/adaptability to disasters/floods. Second, I identified factors known to influence WTP and summarised them (Table 2.4).[7] Third, I categorised these factors into: (1) flood risk; (2) perceptions/attitudes towards flood and perceptions about the validity or acceptability of the hypothetical (CV) scenario; and (3) socio-demographic descriptives of individuals and households.[8] Finally, drawing from the literature, I developed a series of hypotheses (highlighted in italics overleaf) and a conceptual model that shows how I expect WTP to be influenced by each category of variables shown with bold arrows in Figure 2.1. A more detailed explanation of my underlying hypotheses, the model and the literature underpinning the model is provided below.

Table 2.4: Factors which previous studies have found to be associated with willingness to pay for flood prevention.

Determinants	**Sources**
Flood risk	
House distance to/from the river	Zhai et al. (2006); Botzen et al. (2009); Brouwer et al. (2009); Botzen, Aerts and van den Bergh (2013); Bui and Nguyen (2014); Ghanbarpour and Saravi (2014)
Flood water height	Fuks and Chatterjee (2008)
Probability of flood (or flood experience)	Zhai et al. (2006); Navrud et al. (2012); Veronesi et al. (2014)
Flood damages experienced in the past	Brouwer et al. (2009); Shoji (2010); Lantz et al. (2012); Bui and Nguyen (2014)
Evacuation experience or other inconveniences from	Lantz et al. (2012)

[7] I note the importance of adaptability of households to floods, but this is not a focus of this study.
[8] The concept of resilience and adaptability in this paper is not directly discussed here (shown in broken arrows in Figure 2.1. According to the United Nations International Strategy for Disaster (UNISDR) (2015) resilience is the ability '*to resist, absorb, accommodate to and recover'* from floods. This means that individual households with high adaptive capacities transform various types of capitals (e.g. human capital that includes activities that influence future generated monetary and psychic income and also labour power as knowledge, skills, health and motivation) to favourable adaptation measures.

Determinants	Sources
previous floods	
Regional/ location characteristics	Hammit et al. (2001); Botzen et al. (2009); Shoji (2010); Lantz et al. (2012); Navrud et al. (2012); Bui and Nguyen (2014); Crastes et al. (2014)
Individual and household characteristics	
Income	Hammit et al. (2001); Zhai et al. (2006); Fuks and Chatterjee (2008); Brouwer et al. (2009); Bliem and Getzner (2012); Marzetti and Brandolini (2012); Navrud et al. (2012); Crastes et al. (2014); Ghanbarpour and Saravi (2014); Veronesi et al. (2014)
Education	Botzen et al. (2009); Bliem and Getzner (2012)
Age (or age of household head)	Hammit et al. (2001); Bliem and Getzner (2012); Bui and Nguyen (2014)
Household size	Zhai and Ikeda (2006); Bui and Nguyen (2014); Crastes et al. (2014)
Gender	Botzen and van den Bergh (2012)
Head of the household (i.e. whether the respondent is the decision maker at home or has the highest income)	Crastes et al. (2014)
Property value (scale of property) and/or current house and home contents value	Botzen and van den Bergh (2012)
Nationality/immigrant	Bliem and Getzner (2012); Marzetti and Brandolini (2012); Veronesi et al. (2014)
Employment characteristics	Brouwer et al. (2009); Markantonis et al. (2013); Crastes et al. (2014)
Availability of labour (e.g. no. of labourers per household)	Navrud et al. (2012)
House elevation, ownership, or other house characteristics	Zhai and Ikeda (2006); Botzen et al. (2009)
Perceptions/attitudes towards flood and other related risks	

Determinants	Sources
Individual preparedness level [e.g. (flood) insurance, knowledge about evacuation, disaster maps, other practices etc.]	Crastes et al. (2014)
Knowledge about floods and the environment	Hammit et al. (2001); Botzen et al. (2009)
Assessment of flood-prevention/ protection programs/ support facilities/ government (access, close to levee banks, sewage facilities, availability of government compensation, etc.)	Zhai et al. (2006); Fuks and Chatterjee (2008); Botzen et al. (2009); Brouwer et al. (2009); Glenk and Fischer (2010); Shoji (2010); Marzetti and Brandolini (2012) Crastes et al. (2014); Veronesi et al. (2014)
Perception of flood risk and/or inconvenience	Zhai and Ikeda (2006); Botzen et al. (2009); Glenk and Fischer (2010); Botzen et al. (2013)
Perception of non-flood risk (other risks)	Zhai et al. (2006); Bliem and Getzner (2012); Botzen et al. (2013); Veronesi et al. (2014)
Perception of own flood risk relative to others	Botzen, Aerts and van den Bergh (2013)
Risk seeking behaviour	Lo (2013); Veronesi et al. (2014)
Attitudes towards donating/ conservation	Glenk and Fischer (2010); Bliem and Getzner (2012); Marzetti and Brandolini (2012)
Other related determinants	
Bid prices	Crastes et al. (2014)
Influence of peers, family and community	Lo (2013)
Tourism / environmental activities	Marzetti and Brandolini (2012); Veronesi et al. (2014)

Hypothesis #1 (H1): All else constant, households who experience more frequent floods and/or with larger mean flood monetary damages are willing to pay more for flood prevention than other households.

Numerous researchers have found that exposure to flood (using various proxies: number of floods experienced, residence of flood-prone area, etc.) (Brouwer et al., 2009), floodwater depth (Fuks & Chatterjee, 2008) and flood damage (Brouwer et al., 2009; Shoji, 2010; Lantz et al., 2012) affect WTP. There is also evidence of a positive link between flood damage and WTP in less affluent countries. Navrud et al. (2012) found that damages were positively correlated with households' willingness to contribute labour for mitigating flood impacts. Evidently, residents who are impacted more (in terms of flood exposure and/or monetary damage) are likely to be willing to pay more to prevent future flood damage than those less impacted.

Hypothesis #2 (H2): Irrespective of actual flood exposure, people with different attitudes will have different perceptions about floods and flood risk, which influences WTP for flood prevention; these attitudes also influence reactions to hypothetical scenarios presented in a CV with further influence on WTP: (1) households, which are more aware about flood risk and who have positive attitudes towards conservation are willing to pay more; and (2) high credibility and trust in the feasibility of the WTP scenario positively influence the level of WTP.

Most flood valuation studies include attitudinal questions, with ex-post analyses of results and discussions, about the way in which attitudes influence WTP (Fuks & Chatterjee, 2008; Brouwer et al., 2009; Navrud et al., 2012; Bui & Nguyen, 2014; Ghanbarpour & Saravi, 2014). This research indicates that even households with similar flood risk will have different WTPs, much depending on attitudes.

First, people's general attitudes and perceptions are correlated with willingness to contribute to flood prevention programs that benefit the wider community. Bliem and

Getzner (2012), Marzetti and Brandolini (2012) and Glenk and Fischer (2010) found that those individuals who were positive about donation or conservation were willing to pay more for flood prevention than others. This likely reflects the fact that flood mitigation programs generate community-wide (public good) benefits, rather than simply private benefits, so altruistic attitudes matter.

Previous research has also shown that WTP for prevention activities is influenced by people's understanding and opinions of flood risk (Wijayanti et al., 2015). Simply put, if people do not think they are at risk of future flooding (irrespective of whether they are or not), they are less likely to contribute to mitigation programs. Researchers have found that these perceptions of risk are correlated with broader attitudes (Zhai & Ikeda, 2006). Bliem et al. (2012) and others (Zhai et al., 2006; Botzen et al., 2013; Veronesi et al., 2014) explored perceptions of non-flood risk (e.g. river quality, urban/disease risks or other environmental risks) and came to similar conclusions. As such, I expect that perceptions and attitudes about a wide variety of factors such as flood risk; conservation and the importance of making public donations will influence WTP.

Second, people must feel that the hypothetical scenario that is presented to them in a CV study is credible and they must *'trust'* the institutions identified within the scenarios as the group responsible for collecting the '*donations'* and administering the fund designed to implement the flood mitigation measures. If they do not find the scenario credible, or do not trust the institutions identified, their stated WTP will reflect those problems rather than their *'real'* willingness to contribute to flood prevention programs. Many studies (e.g. Glenk and Fischer, 2010; Shoji, 2010; Marzetti and Brandolini, 2012; Crastes et al., 2014; Veronesi et al., 2014) have found that people's perceptions about the efficacy of current projects (Zhai & Ikeda, 2006; Glenk & Fischer, 2010) and about their overall *'trust'* in government (Bliem & Getzner, 2012; Veronesi et al., 2014) affect WTP. In less developed countries, public institutions are often viewed as being somewhat untrustworthy (Whittington, 1998), so perceptions and attitudes may have a stronger and perhaps more complex impact on WTP in less affluent countries than elsewhere.

Hypothesis #3 (H3): Socio-demographic and economic characteristics are likely to be associated with: (1) flood risk; (2) perceptions/attitudes about flood and flood risk; (3) perceptions/attitudes about the CV hypothetical scenario and (4) WTP. That is: (1) households with more children, fewer occupations, lower household income, fewer adults and respondents, who are older, female or less educated experience higher levels of flood risk; (2) rich and bigger households as well as respondents who are older, have positive perceptions/attitudes towards flood risk and conservation (and related concepts); (3) respondents who are educated, with livelihoods depended on water resources; and (4) respondents who are female, less educated, and household with low income, less children, low diversity of household occupations, have low WTP.

Many studies of WTP for flood prevention programs have considered a range of socio-demographics, finding that floods impact people from different socio-demographic groups differently – although relationships vary from study to study.

Flood risk is socially differentiated, as shown in a large volume of published studies describing the role of individual and household characteristics to flood risk. The young and old are often marginalised because of their financial dependence and limited mobility during disasters (Cutter et al. 2003; Schneiderbauer, 2007). Females are also more vulnerable (Wisner, 1998). This is apparent in Bangladesh where women are more impacted by flood because of *'the patriarchal nature of society, the position of women, their needs, level and perception of risks, vulnerabilities and capacities are different in comparison to those of men'* (Azad et al., 2013, p. 192) and because of their greater involvement in household, sector-specific jobs with lower wages (Cutter et al., 2003). Clark et al. (1998) also demonstrated that education might serve to minimise flood effects. This view is supported by some studies, which illustrate that more educated and well-informed residents have access to disaster-related information (Schneiderbauer, 2007). Also, they can lobby for political and civil rights (Khan & Salman, 2012) and empower individuals in communities (Ebay, 2007).

Some studies have found that larger households are also more adversely impacted by floods than smaller households because there are more people (and belongings) affected (Zhai et al. 2006; Lo, 2013; Crastes, et al., 2014). This implies that large households face an additional burden of extra food expenses. Others (Cutter et al., 2003; Bui & Nguyen, 2014), however, noted that household size also influences adaptive capacity through social support and availability of labour for mitigation measures for their families. Linnekamp, Koedam and Baud (2011) demonstrated that larger households have more help and proactive roles (e.g. cleaning households after floods); therefore, they may be able to minimise flood impacts.

Each source of income has varying risks, where some are vulnerable to flood (e.g. occupations with high resource extraction) and some are not (e.g. remuneration from office work). Defiesta and Rapera (2014) identified that Iloilo farming households with higher damages from climate-related disasters usually rely on one or two sources of income and have high adaptive capacity. Similarly, Cinner et al. (2015) found significant differences in climate change adaptive capacities between various social groups (e.g. aged and migrant groups) of Kenyan fishermen. Specifically, non-migrants or those with low participation in local decision-making have low occupational multiplicity. Therefore, households with multiple sources of income also have varying vulnerabilities, which can enable households to manage and adapt to climate change and/or to disasters such as flood events.

Households who are mentally, physically and financially able to undertake flood prevention tasks will have more adaptive capacity and will thus be likely to suffer less damage from floods than other households. Most families adopt various labour-intensive strategies to minimise their damages, such as improving house conditions (Lopez-Marrero, 2010), putting up flood walls, or migrating to flood-free areas (Wisner et al., 2004). Labour-intensive mitigation undertakings at communal levels were recorded in Jakarta; building small levees, communal works for drainage and river clean-up (Marfai et al., 2015). Evidently, more support from abled family members explains low flood damage, even for those with limited access to finance/credit or those who conduct minimal preventive activities.

A large and growing body of literature has investigated the relationship between socio-demographic characteristics (both at household and individual levels) and perceptions/attitudes towards disasters/flood risk. Codjoe and Afuduo (2015) investigated Ghanaian households' flood vulnerabilities by asking the head of the household, *'Do you perceive your household to be vulnerable to floods?'* They found that those households with remittances and who resided in rich neighbourhoods perceived that their households were not at risk of floods. On the other hand, Lo (2013) found a significant correlation between household income and household size to the amount paid in flood insurance. In addition, Busetta and Milito (2010) suggested that young individuals (15 to 34 years old) are socially disadvantaged because they face multiple socio-economic vulnerabilities (e.g. finding a job, ending or completing studies, etc.). This implies that their perceptions/attitudes may differ compared to other age groups.

Different social groups may also have different perception/attitudes. Slovic (1987) has shown that individual subjective perceptions of risk differ significantly from judgements of experts in the field (i.e. an objective measure of risk). Slovic's (1987) work was complemented by Botzen et al.'s (2009) study on perception of risk and mitigation activities (insurance) in the Netherlands. Moreover, perceptions of non-insured Australian households about the purchase of insurance were greatly affected by social expectations (e.g. expectations that friends and other family members will insure respondents' house against floods) (Lo, 2013).

Conversely, previous studies have also found that perceptions of flood risk influence demand for prevention more than socio-demographic attributes do (Botzen, et al., 2009; Botzen et al., 2013). A similar conclusion was found in the investigation of Vietnamese flood protective activities in the household, where perceptions of flood probabilities and flood damage influenced these activities more than their socio-demographic characteristics, especially income (Reynauda, Aubert, & Nguyen, 2013). Evidently, floods affect individuals and households differently, partly because of the differences in socio-demographic characteristics.

Numerous studies have examined factors that may influence the credibility of the CV scenario; one of which is the effect of various socio-demographic characteristics. A trusted institutional setting (e.g. trusted organisation to handle the payment) and an acceptable payment vehicle (e.g. donation or taxes) are important components of the scenario. Some researchers conjectured that individual perceptions explain the content validity of the WTP scenario (Bateman, et al., 2002; Haab & McConnell, 2002; Alberini & Kahn, 2006; Hausman, 2012)[9] and their inclusion in valuation studies allows one to examine whether the institutional setting is credible (Arrow et al., 1993; Fuks & Chatterjee, 2008). More details about the challenges of CV surveys will be presented in Section 2.3.4. Most valuation studies ask respondents about their perceptions about the institution that will handle the project/program or motivations relating to their responses to the WTP questions. For instance, in their investigation of flood WTP for flood prevention activities in the Netherlands, Botzen et al. (2009) found that individual perceptions (e.g. about government support, flood risk and other inconveniences and environmental risks) influence responses to WTP. Marzetti and Brandolini (2012) also demonstrated that individuals from different countries have different donation motives, which affected their demand for the Venice flood control program. Vietnamese wanted the government, not private institutions, to manage flood insurance (Bui & Nguyen, 2014), while Filipinos preferred a multi-sectoral institution to handle the payments raised to produce water services improvements in Layawan Watershed in the Philippines (Calderon, Anit, Palao, & Lasco, 2013).

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[9] For example, it asked: *'Are the property rights and the market of the good defined such a way that the respondents will accept the WTP format as possible?'*

Individual differences may also affect respondents' understanding/behaviours towards questions in the survey. For instance, self-reporting bias arises if respondents (dis)agree with survey questions, which they do not fully understand. Likewise, social desirability/acquiescence arises when participants agree with questions, regardless of their true opinions in order not to offend the interviewer (Podsakoff, MacKenzie, & Podsakoff, 2012).

Individuals may also have different levels of altruism (e.g. behaving for morals or social responsibility), so one should control for this possibility when assessing WTP – particularly for a *'public good'* like flood prevention. Perhaps, the first systematic and in-depth investigation on the influence of ethics to contingent valuation (or any non-market valuation) was done by Clive Spash (2000). He used data from WTP for conservation of wetland endangered species and explored various facets of ethics, such as human rights and rights on conservation. Findings show that ethics is seen to be a factor in decisions for conservation. Also in the empirical investigation with recreational values, Dong, Zhang, Zhi, Zhong, and Li (2011) included a variable that captured social morality and donation behaviour and found that they significantly influenced responses.

Individual differences may also impact perceptions/attitudes about the CV hypothetical scenario. Fishermen in Bangladesh believed that embankments decrease their livelihood opportunities, while farmers believed that soil fertility would be affected as well (Brouwer, et al., 2009).

Together, the above studies outline that perceptions regarding the CV scenario can be influenced by individual and household characteristics.

As regards to more general socio-demographic variables; some researchers have found no link between gender and WTP for flood prevention (Navrud et al., 2012; Ghanbarpour & Saravi, 2014). Botzen and van den Bergh (2012) investigated demand for flood insurance and found that being a female may decrease WTP by 24% because they are not as risk seeking as men (Navrud et al., 2012; Ghanbarpour & Saravi, 2014). Also in an investigation into WTP for flood insurance, Botzen and van de Bergh (2012) showed that age negatively affects WTP, while some studies found no significant impact (Zhai & Ikeda, 2006; Zhai et al., 2006; Brouwer et al., 2009).

Research has also conclusively shown that income has a positive and significant effect on WTP, as it reflects budget constraints or affordability of the household or individual (Zhai et al, 2006; Navrud et al., 2012). As noted by Brouwer et al. (2009): *"poverty is both an important determinant of (endogenous) environmental risk - and hence (in) directly of socioeconomic vulnerability and an important constraint of adaptive capacity"* (p. 315). In a book that sets out to determine impacts of disasters, Wisner and his colleagues (2004) noted that around 75% of those affected in the 1977 typhoon in India were poor farming communities.

This highlights the fact that the link between socio-demographics and WTP is complex. This is because socio-demographics do not just reflect an ability to pay, but they are also associated with perceptions of risk, attitudes towards CV scenarios and actual flood risk/damages. Clearly, if people from varying socio-demographic backgrounds are impacted by floods differently and are also differently equipped to adapt to those impacts, then this will almost certainly influence their WTP for flood prevention programs.

Earlier, I explained that there are (socio) economic, environmental, and individual/household factors that may explain peoples' vulnerability to disasters. I have also shown that disasters are multifaceted because they comprise overlapping and broader dimensions. Although, not covered in this thesis, I recognise the influences of the socio-cultural context and the political processes that shape the vulnerability of a household (Wisner et al., 2004; Shaw, Pulhin, & Perreira, 2010). The discourses of the significance of socio-cultural and political processes are well-studied in other fields of social science such as history, anthropology, political science, and sociology.

Two aspects worth mentioning in this thesis are the unequal distribution of resources and the changing nature of power relations. Households are marginalised because of their geographical location (Wisner, 2004) and the unequal power distribution embedded through culture and politics (Wisner & Luce, 1993). For example, colonised countries have experienced widespread transformations brought about by political and economic aspirations. The political and economic changes experienced in colonised countries, for example Indonesia and Brazil, have led to challenges to the power relations of key stakeholders in these states such as the governments, local communities and individual households (Bryant & Bailey, 1997; Bryant, 1998). These examples have shown how former colonies have been exploited by the capitalistic Western nations with respect to their vast natural resources (Watts, 1983; Rush, 1991). In both cases, the shifting nature of power is exposed – particularly the power over the resources which has effectively been shifted from the locals to the colonisers and/or local elites. Through time, these elites have accumulated wealth and power over these resources that even after the independence of both countries, the elites still control most of the economic and political activities of the respective countries of Brazil and Indonesia (Bryant, 1993). Also, in Thailand institutional arrangements allow the elites *'to deploy experts and technical tools in ways that serve their interests and not those of less politically empowered and socially vulnerable groups'* (Lebel, Manuta, & Garden, 2011, p. 52).

2.3.2. Research gaps relating to the CV method and disaster/flood valuation

First, most flood valuation studies have been done in developed countries and have only been carried out in a small number of areas. In particular, investigations in Europe (the Netherlands, France, Italy and Austria) and in rich non-European rich countries (Canada and Japan) used various flood valuation techniques, elicitation methods and estimation techniques; but relatively few have been done in less affluent countries (recall Table 2.3). There has been limited quantitative analysis of flood prevention in less affluent and known flood-prone countries, such as Cambodia, the Philippines and Vanuatu – although a few investigations have been done in Brazil (Fuks & Chatterjee, 2008), Vietnam (Navrud et al., 2012) and Bangladesh (Brouwer et al., 2009). It is not clear if results can be transferred from developed contexts to socially disadvantaged areas, such as in less affluent countries.

Second, most CV studies of flood have either used data relating to a single (extreme) event in their assessments (determining WTP to prevent a single extreme event), or they have assessed flood damages using secondary regional-level flood damage data (e.g. flood depth, taken from GIS database), drawing inferences from that data about the likely impact on individuals (rather than measuring impacts directly). It is not clear if results from these studies are transferrable to the more general problem of determining how much should be spent on (general) flood prevention.

Lastly, another area that has not been properly investigated is the fact that interrelationships of flood determinants are not properly controlled for in most WTP models for flood prevention. Although researchers acknowledge the complex interrelationships between WTP, actual flood damage, flood risk and perceptions/attitudes, these inter relationships have not been given much attention. Usually, these determinants are simply included within a WTP model, and interpreation is done after the event. Estimates of WTP may thus have been under or over estimated.

2.3.3. Objectives

Following the gaps mentioned in the previous section, the second main objective is:

General objective #2: Determine how much households are willing to pay to avoid future flood damages. Specifically, to assess WTP for flood prevention after using self-reported measures of flood damages in the equation and controlling for complex inter relationship between relevant variables.

By meeting this objective, I will generate valuable empirical information about WTP in my case study area. I will also make a general contribution to the literature by improving understanding of the drivers of WTP (and relationships between these drivers).

2.3.4. Potential problems with the CV estimate (WTP)

The CV and other non-market valuation methods have been tested intensively (Arrow et al., 1993; Carson et al., 2001). It has been thoroughly reviewed by Mitchell and Carson (1989) and Portney (1994) and guidelines for administering CV survey have been set (Hausman, 1993; Bateman, et al., 2002; Alberini & Kahn, 2006). However, the method is not without controversy: its reliability and credibility have also been widely debated (McFadden & Leonard, 1993; OECD, 2002, Hausman, 2012). Below, I focus on key problems.

First, the final estimates from CV studies depend crucially on the way respondents answer surveys. Amongst other problems, respondents may display strategic behaviour and may not tell the *'truth'* when answering the survey (Mitchell & Carson, 1989; McFadden & Leonard, 1993). Respondents may, for example, free-ride and understate their WTP/WTA, thinking they can use the good in question, even without paying for it. Clearly, strategic bias cannot be entirely eliminated - although, there is some evidence that it does not significantly affect outcomes [see for example Baral, Stern, and Bhattarai's (2008) valuation study on ecotourism values in Nepal and Ma et al.'s (2015) analysis using various data collection method].

In addition, behaviour in the hypothetical setting may be different from the actual setting. In their review of economic valuation methods, Rolfe and Dyack (2010) compared the CV and the Travel Cost (TC) methods in valuing recreational values by examining once-only and repeat visitors of the Coorong on the Murray River in Australia. They found that there is empirical evidence that strategic bias exists, which explains lower estimates from some CV studies.

Second, the CV method is prone to hypothetical and strategic biases. Respondents may not take the study seriously and overstate their responses (i.e. pledging), thinking that they need not actually pay for the good as the situation is hypothetical (Dong et al., 2011). Some studies (Murphy et al., 2005) proposed that hypothetical responses are two or three times higher than actual payments. As discussed in Section 2.3, the

CV method assumes that individuals are able to successfully predict their utility in both the current and *'hypothetical'* scenario, and will seek to maximise his/her utility subject to a budget constraint and to other factors (such as flood damages, perceptions/attitudes). Also discussed in Sections 1.2 and 2.2.3, individuals are rarely able to accurately assess flood risk – suggesting that imperfect information is the norm, rather than the exception (Akerkof, 1970; Chivers & Flores, 2002). Consequently, respondents may not be able to accurately assess the way in which the hypothetical scenario will impact utility. Even if not intentionally engaging in strategic behaviour, respondents may thus not be able to generate an accurate estimate of WTP (i.e. one that reflects *'true'* welfare changes). Fujiwara and Campbell (2011) discuss this problem, suggesting that individuals may misreport *'true'* WTP, not because they are being strategic but because they do not fully understand the hypothetical scenario. In situations such as this Simon's concept of '*bounded rationality'* (whereby individuals *'satisfy'* instead of *'maximise utility'*) may prevail.

> *"Agents are boundedly rational in the sense that they are limited in their ability to retrieve, store and process information. They attend to particular pieces of information, ignore others and settle for 'good enough' or 'satisficing' solutions to the problems they face, partly on the basis of their past experience"* (Collet, 2009, p. 422).

Recently, one of the prominent researchers on contingent valuation, Jerry Hausman (2012) emphasised the difficulty, instability, and incoherent outcomes of CV surveys. One significant problem is the hypothetical bias that may be related to interviewer bias (respondents desire to please the enumerator) which may be associated with the fact that no alternatives are available and/or that no discussion with other (individuals/residents) is possible during the survey.

For all of the reasons above, one cannot be certain that responses to questions about WTP for a flood prevention *'good'* or *'service'* that is offered in the hypothetical market will accurately reflect true WTP.

Finally, WTP is constrained by ability to pay. Some studies have identified that an inability to pay hinders individuals from signalling a positive WTP. For instance, Adams et al. (2008) investigated biodiversity conservation in Brazil, finding a strong correlation between ability to pay and WTP, even after having identified and controlled for protest votes. Also in biodiversity conservation, South Africans strongly signify interest for conservation but the majority (around 57%) are unable to pay (Turpie, 2003). Similar findings were also found in the study of Jin, Wang and Liu (2008) about WTP for conservation of endangered bird species in Macao.

Having discussed the challenges of the CV survey, many scholars attempted to minimise these biases through various survey designs and other related precautions. For example, Vossler et al. (2003) compared WTP responses to actual votes in order to control for hypothetical bias; while Desvouges et al. (1996) used interviewer dummy variables to control for possible interviewer bias. In relation to this, Blumenschein et al. (2008) developed a manual for researchers to handle these types of problems. Moreover, proper training of interviewers is also emphasised by Whittington (2002), especially for the conduct of CV surveys in less-affluent countries.

The CV study (described in Chapter 6) attempts to control some of these factors through careful design and analysis, thus minimising potential biases. But, in addition, I explore an alternative valuation technique (below) which is not subject to hypothetical or strategic biases, and which does not assume that individuals have perfect information and behave in a (unbounded) rational manner. Assessing the impact of flood damages on life satisfaction

2.4. Assessing the impact of flood damages on life satisfaction

2.4.1. General literature on life satisfaction in economics

The life satisfaction method (or LS approach [sometimes called the subjective well-being (SWB) approach/method]) estimates the value of non-market goods by looking at how they impact people's subjective well-being (SWB) (Fujiwara & Campbell, 2011, p. 14). Measuring SWB is normally done by asking individuals to provide a mental account of his/her own utility (Dolan & Metcalfe, 2008; Ferreira & Moro, 2010; Ambrey & Fleming, 2011); which includes self-valuations of their positive and negative experiences (Stutzer & Frey, 2010). Unlike stated-preference valuation methods (e.g. contingent valuation), the LS approach assumes that utility (subjective well-being) can be measured cardinally:

$$u(C, Q) \qquad \textit{Equation 3.}$$

where,

C represents any market good/service and

Q represents a non-market good/service.

Empirically, the LS model (in a cross sectional dataset) is expressed as:

$$LS_i = \alpha + \beta_1 y_i + \beta_2 Q_i + \beta_3 \delta_i + \varepsilon_i \qquad \textit{Equation 4.}$$

where,

LS_i is the stated LS of individual i – assumed to represent utility

y_i is the income of individual i ,

Q_i corresponds to the level of non-market goods consumed by individual i, and

δ_i is a vector of characteristics associated with individual i that may influence LS.

One can use coefficient from Equation 4 to infer the *'value'* of the non-priced good (Q:

1) $\widehat{\beta_1} = \frac{\partial LS_i}{\partial y_i}$

2) $\widehat{\beta_2} = \frac{\partial LS_i}{\partial Q_i}$

3) $\frac{\partial y_i}{\partial Q_i} = \frac{\widehat{\beta_2}}{\widehat{\beta_1}}$.

Where, $\frac{\widehat{\beta_2}}{\widehat{\beta_1}}$ is the *'income compensation'* derived from the LS approach, formally the marginal rate of substitution (MRS) of income for Q – or the amount of income that would need to be given to an individual, to compensate them for a reduction in Q (maintaining LS at the original level). Similar to the CV method, the LS approach can thus be used to value non-market goods and allows for substitution of services.

Arguably, Easterlin (1974) is the *'father'* of the LS approach. He used American data and pointed out that growth in income does not necessarily improve overall life satisfaction. I conducted a search in the *EconLit* database and used the following keywords: *'life satisfaction'*, *'happiness'*, *'well-being'*, *'wellbeing'*, *'subjective well-being'* and *'subjective wellbeing'*. There were 14 articles published between 1975 to 1979; between 2010 to 2014, there were 1,207 (Figure 2.2) – clearly demonstrating the rising popularity of this approach.

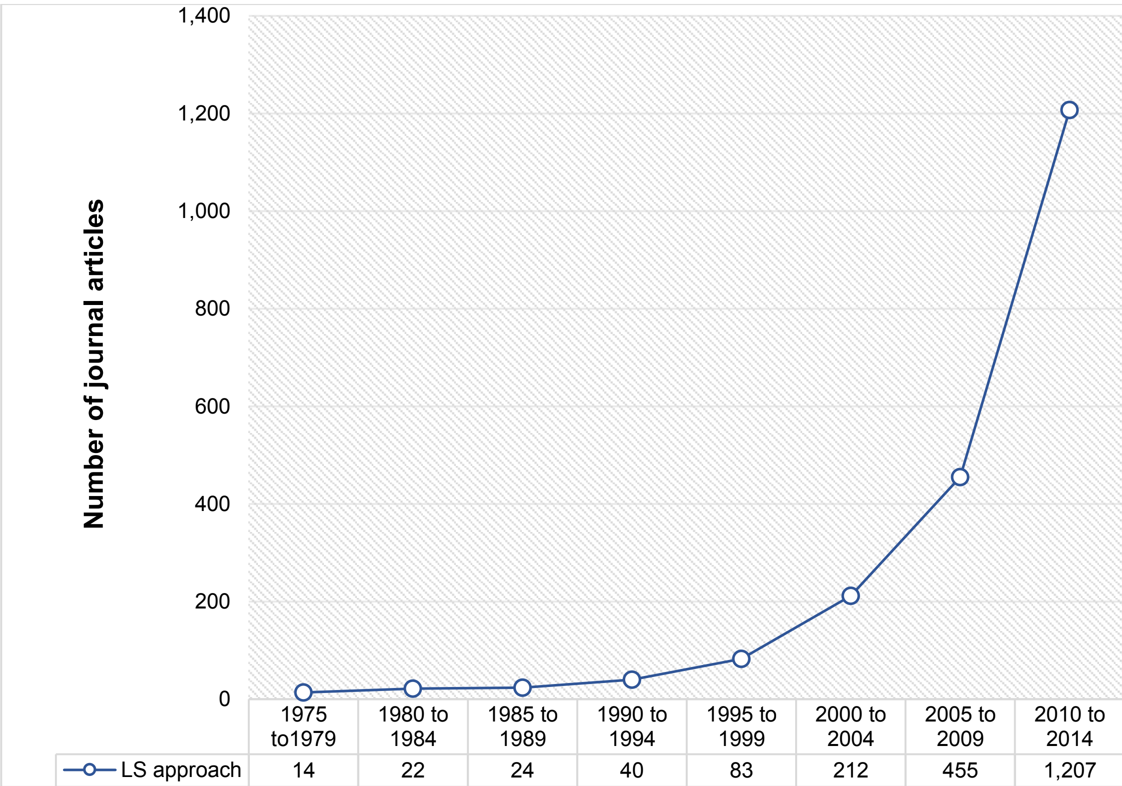


Figure 2.2: Growth of life satisfaction studies in economics.

To the best of my knowledge, Clark and Oswald (2002) and Welsch (2002) were the first researchers to use the LS approach to estimate the MRS between prosperity and non-monetary goods (e.g. pollution and life events). Welsch proposed that the methodology he used could be viewed as *'a complementary to standard valuation techniques such as contingent valuation, or demand-based, weak complementarity methods'* (Welsch H. , 2002, p. 488).

Many studies of life satisfaction have been cross-country studies (i.e. using aggregate variables, for example, over LS at a country level). Examples are: Rendanz and Maddison (2005), Welsch (2008), Stanca (2009) and Maddison and Rendanz (2011). These studies used variables, which measure various constructs such as climate, pollution and relationships between family and friends. They also seek to determine how those factors influence LS. Some studies have analysed LS within a country, using disaggregated variables (e.g. LS of an individual). Table 2.5 summarises key variables used within these studies. Key observations are that life events (illness, marriage and unemployment) affect LS. For example, Clark and Oswald (2002) found that marriage increased LS by an amount equivalent to £70,000 of income per year. Later, Deaton, Fortson and Tortora (2009) studied the impact of life value (in terms of losing an immediate family member because of HIV/AIDS, malaria or tuberculosis) in Africa and concluded that life value estimates are small.

Table 2.5: Factors influencing life satisfaction and the corresponding studies that used them in their analyses.

Natural Capital	Social Capital	Human/built Capital	Environmental Amenities	Socio-demographic characteristics	Other Economic Indicators
Natural capital per capita (Moro, Brereton, Ferreira, & Clinch, 2008)	Participation (consultation, voluntary work, etc.) (Schyns, 2002; Helliwel, 2003; Stanca, 2009)	Employment Status (Di Tella, MacCulloch, & Oswald, 2001; Frey & Stutzer, 2002; Helliwel, 2003; Helliwell, 2006; Moro et al., 2008; Arifwidodo & Perera, 2011)	Temperature (Blomquist, Berger, & Hoehn, 1988; Frijters & van Praag, 1998; Rendanz & Maddison, 2005; Brereton, Clinch, & Ferreira, 2008; Moro et al., 2008; Stanca, 2009; Maddison & Rendanz, 2011)	Age (Frijters & van Praag, 1998; Schyns, 2002; Di Tella, MacCulloch, & Oswald, 2003; Helliwel, 2003; Brereton et al., 2008; Moro, Welsch H., 2008; Stutzer & Frey, 2010)	Unemployment rate (Oswald, 2001; Rendanz & Maddison, 2005; Moro et al. 2008; Welsch H., 2008; Stanca, 2009)
Air pollution Welsch H., 2002; Arifwidodo & Perera, 2011	Trust (Helliwell, 2006; Engelbrecht, 2009)	Education (Blomquist et al., 1988; Frijters & van Praag, 1998; Frey & Stutzer, 2002; Rendanz & Maddison, 2005; Brereton et al., 2008; Moro et al., 2008)	Latitude/ climate (Blomquist et al., 1988; Brereton et al., 2008; Moro et al., 2008; Arifwidodo & Perera, 2011)	Household/ individual income (Frijters & van Praag, 1998; Schyns, 2002; Di Tella et al., 2003; Helliwell, 2006; Brereton et al., 2008; Stutzer & Frey, 2008)	Income/Gross national income per capita (Welsch H., 2002; Schyns, 2002; Rendanz & Maddison, 2005; Deaton, Fortson, & Tortora, 2009; Engelbrecht, 2009; Stanca, 2009; Maddison & Rendanz, 2011)
Ecosystem services product (ESP) (Vemuri & Costanza, 2006; Abdallah, Thompson, & Marks, 2008)	Friends/ Neighbours/ Communiy (Stanca, 2009; Arifwidodo & Perera, 2011)	Health (Helliwel, 2003; Abdallah, Thompson, & Marks, 2008; Brereton et al., 2008; Moro et al., 2008; Welsch H., 2008; Stanca, 2009)	Pollution/Waste (Rendanz & Maddison, 2005; Moro et al., 2008; Welsch H., 2008; Stanca, 2009; Arifwidodo & Perera, 2011; Maddison & Rendanz, 2011)	Gender (Frey & Stutzer, 2002; Di Tella et al., 2003; Helliwell, 2006; Brereton et al., 2008; Arifwidodo & Perera, 2011)	Income inequality (Engelbrecht, 2009)
	Family (marital status,	Human Development	Population density/	Family size/dependants	Inflation rate (Welsch

Natural Capital	Social Capital	Human/built Capital	Environmental Amenities	Socio-demographic characteristics	Other Economic Indicators
	relationship, relatives abroad, etc.) (Schyns, 2002; Helliwel, 2003; Helliwell, 2006; Brereton et al., 2008; Moro et al., 2008; Arifwidodo & Perera, 2011)	Index (Vemuri & Costanza, 2006)	congestion (Frijters & van Praag, 1998; Moro et al., 2008; Abdallah, Thompson, & Marks, 2008; Stanca, 2009; Arifwidodo & Perera, 2011)	(Frijters & van Praag, 1998; Frey & Stutzer, 2002; Di Tella et al., 2003; Brereton et al., 2008; Moro et al., 2008; Stutzer & Frey, 2008)	H., 2008; Stanca, 2009; Maddison & Rendanz, 2011)
	Religion (Helliwel, 2003; Rendanz & Maddison, 2005; Helliwell, 2006; Stanca, 2009)	Scientists/ engineers (Maddison & Rendanz, 2011)	Urbanisation (Helliwel, 2003; Moro et al., 2008; Stutzer & Frey, 2008; Arifwidodo & Perera, 2011)	House type/ tenure (Brereton et al., 2008; Moro et al., 2008; Arifwidodo & Perera, 2011)	
	Crime rate/ security (Blomquist et al., 1988; Brereton et al., 2008; Arifwidodo & Perera, 2011)	Infrastructure (Brereton et al., 2008; Arifwidodo & Perera, 2011)	Location (Frey & Stutzer, 2002; Brereton et al., 2008)	Head of household (Stutzer & Frey, 2008)	
	Institutional variables/Governance (Frey & Stutzer, 2002; Welsch H. ,2002; Rendanz & Maddison, 2005; Vemuri & Costanza, 2006; Welsch H., 2008; Engelbrecht, 2009; Stanca, 2009; Maddison & Rendanz, 2011)			Foreigner/ local (Frey & Stutzer, 2002)	
	Self-reported honesty (Helliwel, 2003)				

The number of studies linking LS to the environment (including effects of pollution to health) is increasing (Rendanz & Maddison, 2005; Moro et al., 2008; Welsch H., 2008; Stanca, 2009; Arifwidodo & Perera, 2011; Maddison & Rendanz, 2011). Using LS data from Household, Income and Labour Dynamics in Australia (HILDA), Ambrey and Fleming (2011) estimated the implicit WTP for scenic amenity in Southeast Queensland in Australia and found evidence of a non-linear relationship between scenic amenity improvement and WTP. Unfavourable environmental conditions such as weather conditions (Blomquist et al., 1988) and pollution (Ferreira, et al., 2013) have been shown to adversely affect individual well-being; so too have natural and human-induced disasters such as forest fires (Kountouris & Remoundou, 2011), droughts (Carroll, Frijters, & Shields, 2009), earthquakes (Chang & Taormina, 2011), hurricanes (Kimball, Levy, Ohtake, & Tsutsui, 2006; Calvo, Arcaya, Baum, Lowe, & Waters, 2014) and nuclear melt-down disasters (Berger, 2010). Indeed, many studies in the fields of public health and psychology have analysed well-being after disasters: survivors and disaster preparedness in New Zealand (Gowan, Kirk, & Sloan, 2014); earthquake rescuers and secondary trauma in China (Chang & Taormina, 2011); and religiosity of tourists and post-traumatic stress in Norway (Hussain, Weisaeth, & Heir, 2011).

In the United States, Smith (1992) found that significant life events such as flood and other disasters have had an adverse impact on American well-being. Taking a public health approach, Tan et al. (2004) examined LS and flood in the Dongting Lake area in China. They examined flood impacts through a natural experiment involving three study groups with similar demographic characteristics and through a generic quality of life inventory-74 (GQOLI-74) questionnaire. They found that in flood affected areas, life satisfaction was lower, likely attributable to post traumatic stress disorder (PTSD). Luechinger and Raschky (2009) also attempted to investigate the impact of floodings on LS using 16 European countries between 1973 and 1998 with flood (and other) data. They found that the levels of LS of individuals were negatively impacted by floods.

2.4.2. Research gaps in the life-satisfaction-disaster/flood literature

In spite of the large and growing literature about disasters and the emerging knowledge and interest in LS research, few have used the LS approach to inform decisions about flood prevention spending. Compared to other environmental issues, a relatively small number of studies have directly investigated the impact of natural disasters (and specifically flooding) on overall life satisfaction, but examples exist (recall Smith, 1992; Tan et al., 2004; Luechinger & Raschky, 2009). To the best of my knowledge, very few have used coefficients from the LS equation to estimate the MRS between income and flood damages (conceptually equivalent to the *'value'* of flood damages).

Second, a potential problem arises because of the scale mismatch between environmental and LS data. The LS approach uses data that is collected from individuals, about their overall satisfaction with life. Data relating to the environment is most often sourced externally. For example, greenhouse emissions are generally reported at the national scale (Andersson, Nässén, Larsson, & Holmberg, 2014); and temperature/rainfall data relate to regions (Carroll et al., 2009; Ferreira & Moro, 2010; Cuñado & de Gracia, 2013). These two types of data are combined to draw inferences about the *'value'* of the environment to individuals (in terms of its influence on LS and the monetary equivalent of that impact) – see, for example, Welsch (2002), Ambrey and Fleming (2011). Aside from the difficulties which arise when comparing data collected from different regions or cultures (Helliwell, 2006) or even comparing data collected from individuals with different personalities or moods (Kahneman & Riss, 2005), an additional problem of unobserved heterogeneity may occur when working with regional-scale environmental data. This occurs because there is no guarantee that a person living in one part of a region will experience the same environmental conditions as a person living elsewhere in that region.

Researchers investigating the cost of air pollution have demonstrated techniques for dealing with the problem of unobserved heterogeneity by, for example, including distance from central business district (MacKerron & Mourato, 2009) or distance from air monitoring system (Ferreira, Moro, & Clinch, 2006). Luechinger and Raschky (2009) also attempted to deal with this problem when considering floods. They dealt with the problem of regional heterogeneity by using a dummy variable to represent a region that had been impacted by floods and then also including a variable, based on flood hazard data, which differentiated regions according to the likely severity of floods that occur within them. Although a marked improvement over studies which do not acknowledge heterogeneity, this approach still fails to fully capture differences in the impacts at an individual level (to match the individual LS data).

The last issue which, to the best of my knowledge, has not yet been properly explored within the LS/environment (natural disaster) literature relates to the fact that individuals do not only judge their well-being according to their own circumstance, but according to their circumstances relative to other people. This was clearly demonstrated by Dusenberry (1949), who noted that it was not only an individual's personal income that affected their well-being, but also their income relative to others.[10] I hypothesise that people's perceptions of the impact of a flood event on their overall well-being will not

[10] Relativity (especially relative income) will be discuss in Chapter 7, including recent developments in life satisfaction research following Dusenberry's pioneering work.

just depend upon the way in which that flood affects them individually, but upon the way in which that flood affects them compared to others in their local community. If relative flood effects indeed matter, distributional effects of flood prevention and mitigation policies at individual and regional levels are critical components in policy making.

2.4.3. Objectives

The research gaps identified above justify the third main objective:

General objective #3: Determine the impact of flood damages on LS, and the amount of income that would need to be paid to flood victims to *'compensate them'* (i.e. to hold LS constant) for the flood damage.

Specifically,

1) Understand the relationship between flood damage and overall LS to look at the determinants of LS by using self-reported monetary flood damages (as opposed to secondary flood data); and

2) Explore the potential impact of relative flood damage – one's flood damage relative to others' flood damages in the community (next to absolute flood damage) on LS

    - Estimate how much income would need to be paid to an individual to compensate them for flood, assuming that everyone in the community is affected; and

- Estimate how much income would need to be paid to an individual to compensate them for flood, assuming they are the only person in the community who is affected.

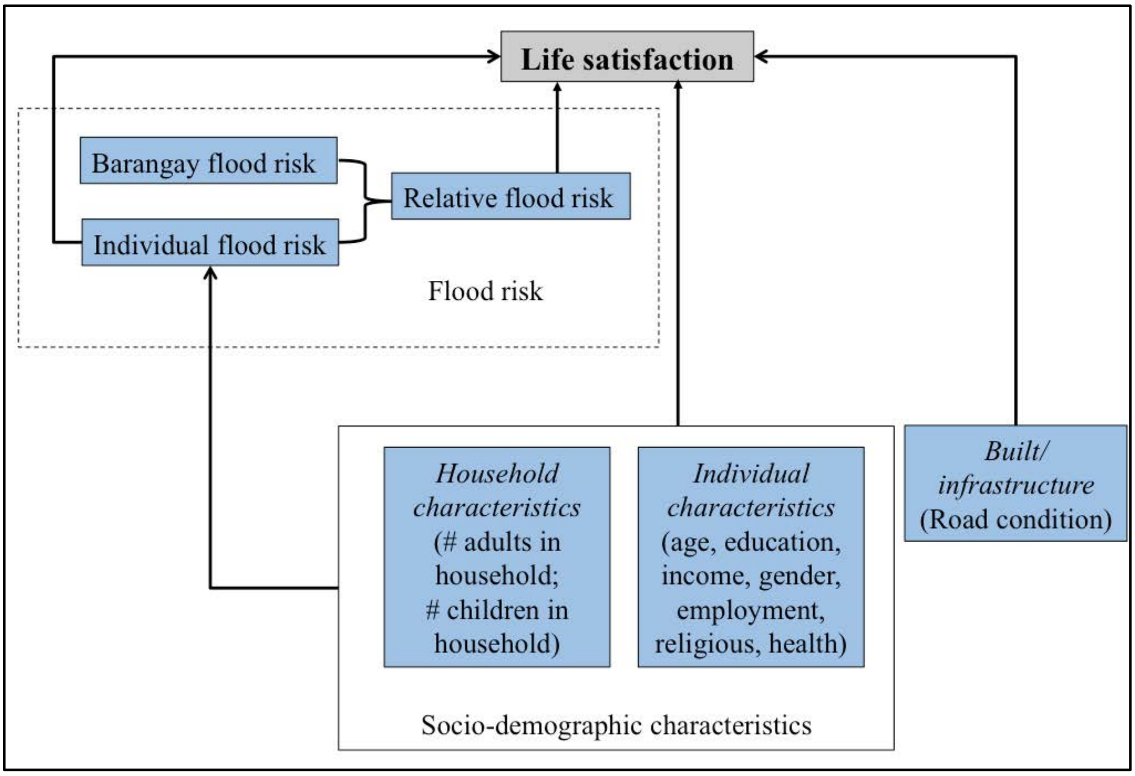


Figure 2.3: Hypothesised framework of life satisfaction approach in valuing flood prevention.

This particular investigation of my thesis addresses the following hypothesis: (1) A resident who experienced higher absolute flood risk and / or higher relative flood risk will have lower life satisfaction; (2) a resident who is in good health, committed to faith, rich, highly educated, female or (securely) employed will have higher life satisfaction; while less adults and children in the household will reduce life satisfaction and (3) good quality built capital (such as roads and other infrastructure) in the neighbourhood of respondents' positively affects their life satisfaction. These relationships are shown in Figure 2.3 and will be discussed in detail in Chapter 7.

2.4.4. Potential problems with life satisfaction estimate

Despite the growing empirical evidence on efficacy of the LS approach, as a method for estimating economic value; the method is not without limitations. In particular, estimates generated from the LS equation may not reflect the *'true'* welfare estimates.

First, there have been debates about whether SWB (e.g. LS score) is a *'good'* measure of utility. *'Good'* in this context requires that: (1) individual measures of SWB validly and reliably reflect personal judgements – i.e. that people's subjective judgements reflect their ideals of good life (and that these judgements are reliable and replicable) (Frey, Luechinger, & Stutzer, 2010; Stutzer & Frey, 2010); and (2) reported measures of utility (LS) are interpersonally comparable. Kristoffersen (2010) argues that psychologists have firmly established that interpersonal comparability is possible. Others have explored the *'validity'* of SWB responses, e.g. Sandvik, Diener and Seidlitz (1993) who compared self-reported and non-self-reported well-being. They found that both measures statistically converge and that the SWB measure is highly correlated to *'theoretical constructs of SWB'* such as family and friends. Frey and Stutzer (2002) also present much evidence on the validity of measures of SWB. Therefore, it seems that the LS score is a valid cardinal measure that can be used to make intra and interpersonal comparisons.

That said, because the LS approach uses self-reported measured LS, there is potential for survey bias. Two of the most common problems are those associated with (1) social desirability bias and (2) context effects. Answers to the LS question (e.g. '*How satisfied are you with your overall life, today?'*) may be distorted because respondents want to *'present themselves in a positive light'* (Krumpal, 2013). Similarly, the research instrument and order of questions influence responses; for example, preceding questions/tasks to the LS questions. Several studies have been carried out to support this. In 1988, Strack et al.[11] compared two scenarios where one set of question order and the other on reverse order. They found that there is a significant positive correlation between survey questions, in the reverse order set. In the same vein, Bertrand and Mullainathan (2001) examined people's responses to subjective questions and found that *"people attempt to provide answers consistent with the ones they have already given in the survey"* (p. 67).

2.5. Chapter summary

The lack of knowledge of how much to spend exemplifies a significant constraint in planning and developing programs for preventing disasters or flood impacts. The market for flood prevention fails at least partially because prevention is a public good; the market is also affected by imperfect information. However, it is difficult to determine how much *'should'* be spent on flood prevention, primarily because it is so difficult to assess the *'true'* welfare costs of floods.

I discussed three techniques for assessing the value of flood damage prevention – the (market based, direct) flood damage assessment; the widely accepted contingent valuation (CV); and the newer LS approach. All three intend to measure the *'value'* of flood prevention, but each has its own advantages and disadvantages. The flood damage assessment uses market prices for valuation while the last two, respectively, use indirect and direct utility functions to value flood prevention. Despite their respective popularity in various disciplines (e.g. flood damage assessment in planning, LS approach in behavioural economics/psychology and the CV method in economics), they all suffer

[11] as cited in Fujiwara and Campbell (2011)

from their own weaknesses that may prevent them from generating empirically valid estimates of welfare.

To illustrate the relationship between the three models, I summarise the frameworks presented in Sections 2.2, 2.3.1 and 2.4 into one overarching conceptual framework (Figure 2.4). The WTP approach (unique relationships shown in green) is cognitively more complex than the damage assessment (shown in red) and life satisfaction approach (unique relationships shown in blue). This relative complexity arises, because the WTP approach is forward-looking (willingness to pay to prevent future flood damage), which means respondents need to form expectations about future flood risk and the feasibility of the flood prevention scenario (dotted-lined boxes in Figure 2.4 indicate expectations). In contrast, the flood damage assessment and the LS approach are backward looking approaches focussing on current flood risk (flood damage approach) and current flood risk, current life satisfaction and current income (LS approach). Since current flood risk is a predictor of future flood risk, current flood risk is common to all three valuation approaches. Specific to the WTP approach is the inclusion of perceptions about the flood prevention scenario (as a predictor of the expected feasibility of the flood prevention scenario) and perceptions and attitudes about flooding in general (which affect willingness to pay). Specific to the LS approach is the inclusion of contributors to life satisfaction other than floods (for example built capital) and an explicit acknowledgement that a person's life satisfaction may depend on how flooding affected them relative to others in the community. Finally, the WTP approach is conducted at the household level; the LS approach at the individual level, which explain why the former includes household income, while the latter includes individualised income.

Therefore, I conclude that conceptually, the three models estimate the demand for flood prevention, but the outcomes are expected to be different due to methodological and analytical differences (to be discuss in Chapter 4).

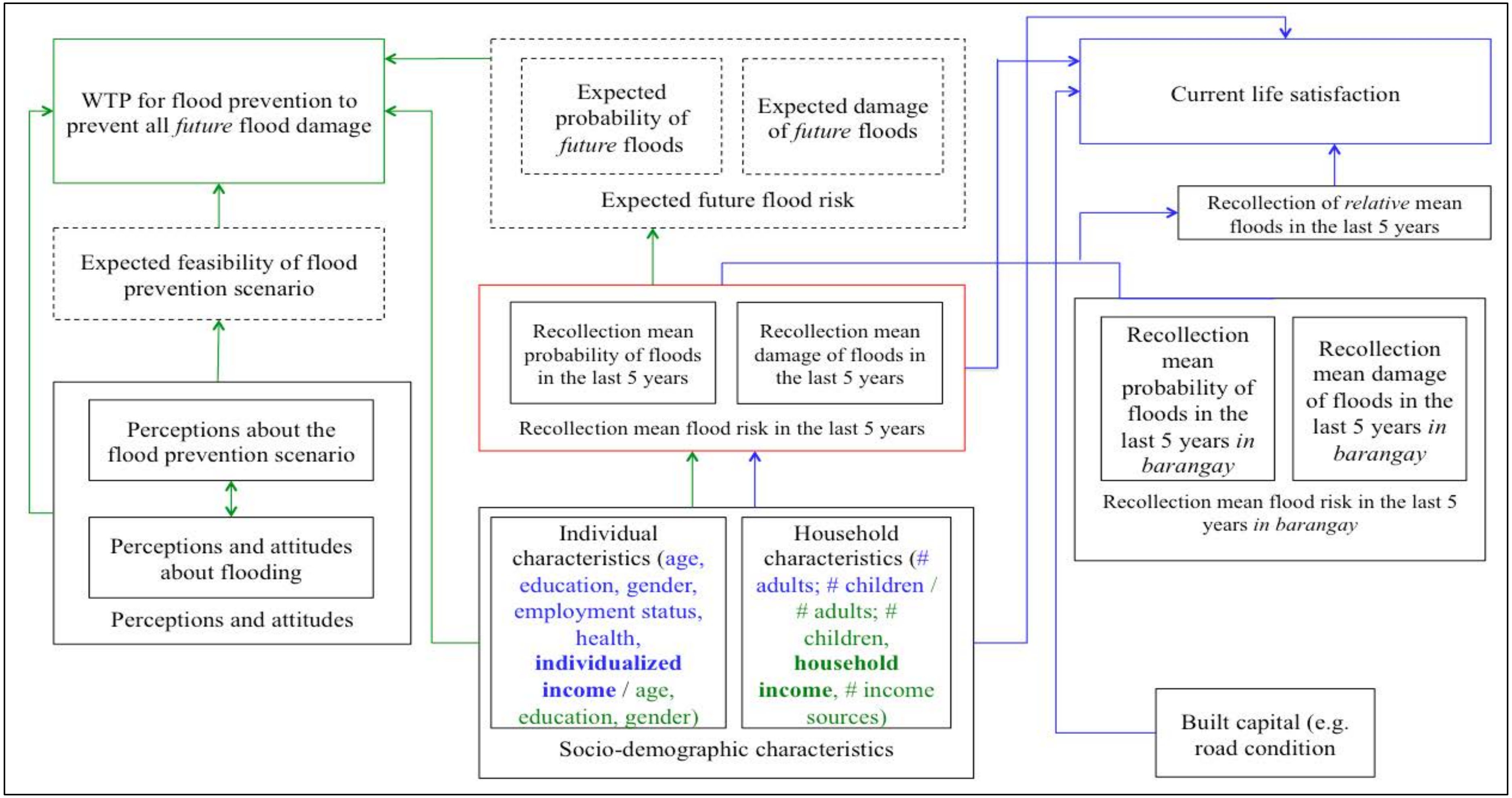


Figure 2.4: Differences between three valuation methods.

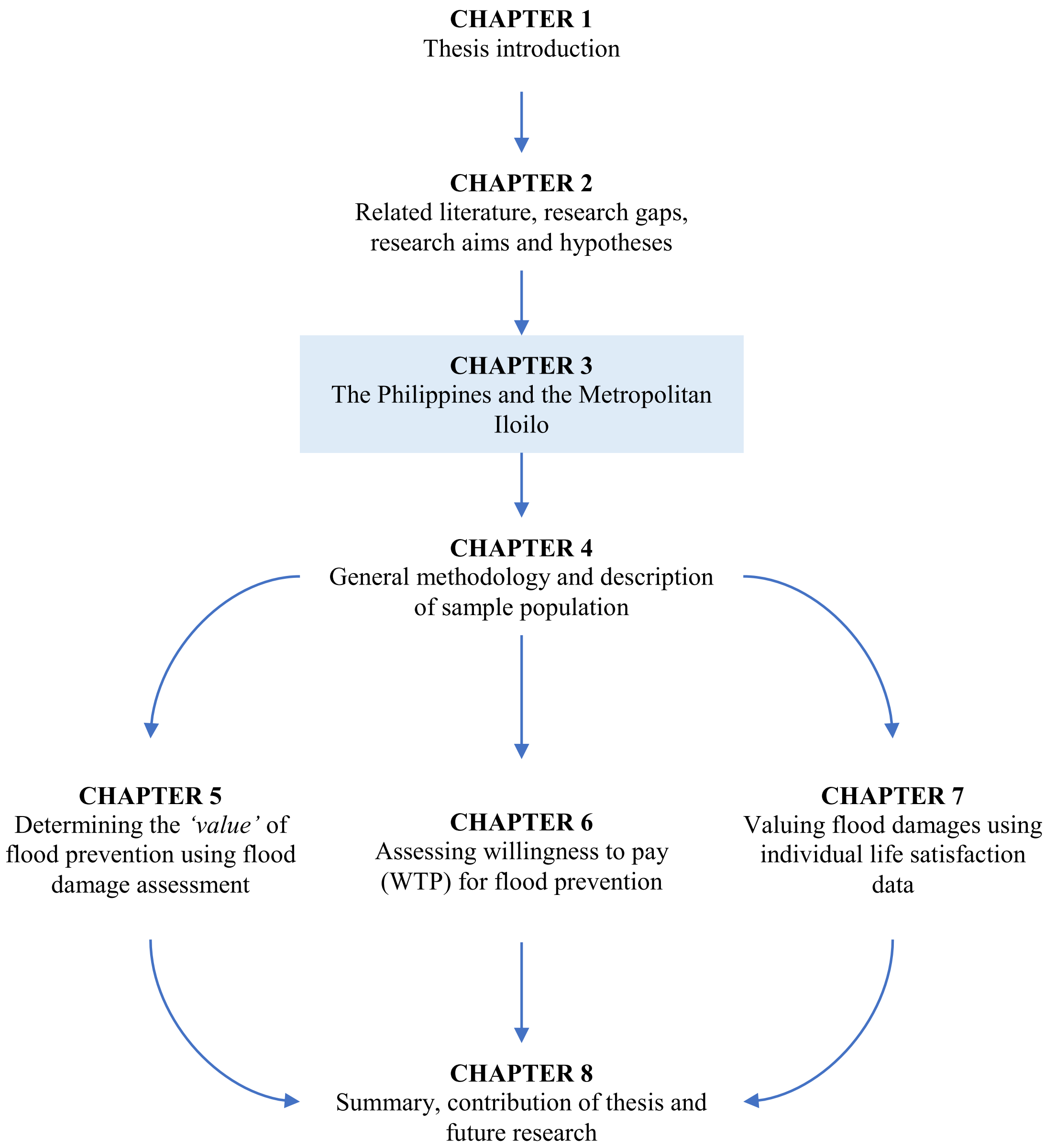
Furthermore, I do not expect estimates from either the CV or the LS approach to equal actual estimates of flood damages, since flood damage estimates do not capture intangible impacts. Both the CV and LS approaches allow for intangibles by focusing on the trade-off between income and flood damages. Moreover, differences on the outcomes from these methods may also arise due to the fact that people undertake private activities (e.g. moving or elevating house) to mitigate flood damages, instead of paying for public goods.

To the best of my knowledge, no other researcher has used all three approaches in a single location/context, although there are a few studies which have compared pairs of valuation techniques. Levinson (2009) compared estimates of the '*value*' of environmental improvements from both revealed and stated preferences approaches, finding that these were much lower than values derived from LS approach. Perhaps one of the most comprehensive studies, which analyse the relationship between outcomes from the CV and LS approach, was done by Dolan and Metcalfe (2008). They used data from a survey of British households about their WTP for regeneration of houses. They theorised that when the initial income and change in the quality of the non-market good were the same, the WTP from the CV study and the *'income compensation'* from the LS study should be equal. Results show that the two estimates are not equal and the authors suggest more empirical research in comparing these two approaches.

While there are many areas throughout the world that are impacted by floods (and predicted to be impacted more frequently with climate change), I have opted to undertake my study in a less affluent country – the Philippines. Over the past decades, economic valuation techniques have become an increasingly popular way of assessing demand for and WTP for flood prevention (Lindsey, Paterson, & Luger, 1995). These techniques, however, have not been widely-used in less affluent countries. Also, despite high disaster vulnerabilities of less affluent countries, such as the Philippines, researchers have given less attention to these areas, in term of using economic valuation techniques to estimate the *'value'* of flood prevention spending.

The next chapter describes the case study area, the Metropolitan Iloilo in the Philippines, and discusses why I chose it to answer my thesis objectives.

Thesis outline



3: The Philippines and the Metropolitan Iloilo (MI)

Chapter outline

Chapter 3 aims to describe the case study area. This chapter begins by outlining the fact that the Philippines is one of the most vulnerable countries in terms of disasters; whose impacts have severely affected its economy, environment and day-to-day living of people. I also discuss that these impacts will become worse in the future because of changes in the climate and rapid growth of built environment and population. More importantly, this chapter demonstrates that the Philippine government recognises the need for better *'well-being'* measures but to no avail – which gives researchers opportunities to explore the impacts of floods to well-being and to estimate how much spending should be done on well-being improvements (e.g. spending on flood prevention). I also present arguments as to why the MI region is an appropriate study area to answer the objectives of this thesis.

3.1. Philippine profile

The Republic of the Philippines is an archipelagic economy located in Southeast Asia (SEA). The total land area is around 300,000 square kilometres and is administratively divided into three major island groups: Luzon (seven regions), Visayas (three regions) and Mindanao (six regions). Partly due to its location and topographical makeup, the country experienced both natural and man-made hazards (Luna, 2001; Lasco et al., 2009). It is considered to be one of the most vulnerable countries in the world, ranking second (only behind Vanuatu) among disaster hotspots, according to the World Risk Report (UNU- EHS, 2014). It lies west of the Pacific Ocean and consists of island clusters (around 7,000), which are affected by around 20 typhoons every year (Lasco et al., 2009; Yumul et al., 2012).

Flood is one of the dominant hazards in the country, which has the highest number of occurrences recorded from 1990 to 1995 (Luna, 2001).[12] Moreover, in the investigation of Yusuf and Francisco (2009), flood is identified as a major problem, specifically in the National Capital Region (NCR) in Luzon, which is the most vulnerable among the regions in the country, because of its high exposure to typhoons and densely populated communities. However, based on multiple disaster risk indices, all regions in the country are categorised as *'highly vulnerable'* because they also experience multiple hazards, such as typhoons, floods, droughts and landslides (Yusuf & Francisco, 2009). Data from the National Disasters Coordinating Council (NDCC), a nationwide agency in-charge of policies and coordination of disaster management in the Philippines, estimated that the average damage from flood (including flash floods) and typhoons is around two-thirds of the total annual hazard losses (Benson, 2009). Figure 3.1 shows images of impacts of floods and other associated disasters in the country, which arguably shows the influence of disasters to the well-being of households and communities.

[12] Other hazards are also related to floods, such as typhoons, landslides (avalanche), and tornadoes.

Figure 3.1: Impacts of floods and other related disasters in the Philippines.

Aside from environmental factors, Filipinos are highly vulnerable to hazards because of economic and development challenges in the country. Table 3.1 summarises relevant indicators that are available for the Philippines.

Table 3.1: Selected economic, demographic and disaster data of the Philippines.

Economic and demographic indicators	**Environmental/disasters indicators**
Total land area: 300,000 sq. km (coastline - 36,289 km)	Climate: tropical marine; northeast monsoon (November to April); southwest monsoon (May to October)
Gross Domestic Product (GDP): $692.2 BN (2014)	Average no. of typhoons: over 20 typhoons affect the country annually (8 or 9 making landfall)
GDP per capita: $7,000 (2014)	Mean annual temperature: 26°C (1971-2000)

Economic and demographic indicators	Environmental/disasters indicators
Unemployment rate: 6.8% (2014)	Typhoons season: between June and December.
Population below poverty: 25.2% (2012)	World Bank (WB) prediction: Heavy rainfall associated with typhoons and other weather systems may increase in both intensity and frequency under a changing climate. This could exacerbate flooding in existing flood-prone areas and increase landslide and mudslide risk, as well as introduce flood risk to new areas.

Sources: CIA (2015) and WB (2015).

As mentioned in Chapter 1, the IPCC (2014) and World Risk Report (UNU- EHS, 2014) predicted that floods and typhoons will occur more often and that economic development and overpopulation in urban areas will exacerbate flood impacts in the future. The Philippines has a large population of 95M, 66% of which live in urban areas (UNDP, 2012; WB, 2012). Around 11.8M people reside in the capital Manila alone, while the population is expected to increase to 142M in year 2045 (PSA, 2014). Growth rates are 2.2% and 1.2% for urban and rural populations, respectively (UN, 2015).

The country is a low-middle-income economy and is classified as *'emerging and developing'* by the International Monetary Fund (IMF); it is also one of Asia's largest economies, with an estimated 2014 Gross Domestic Product (GDP) of US$692.2BN (CIA, 2015). The main driver of economic growth in the Philippines is the service industry, which makes up more than 50% of the country's economic activities. With a growing economy, the country has yet to improve the standard of living of its population. For instance, around a quarter of the population live on less than US$1.25 per day and 35% of Filipinos still work in the agricultural sector (NSCB, 2008; UNDP, 2012; CIA, 2015). Despite having a HDI '*medium-human development'* (0.630), the Philippine HDI is lower than the mean indices of East Asia and the Pacific (0.671) and of the world (0.682) (UNDP, 2012). Moreover, of the eight Millennium Development Goals (MDG) set by the United Nations, five goals are still not achieved: (1) Eradicate extreme poverty and hunger (Goal 1); (2) Achieve universal primary education (Goal 2); (3) Promote gender equality and empower women (Goal 3); (4) Improve maternal health (Goal 5); and (5) Combat HIV/AIDS, malaria and other diseases (Goal 6) (NSCB, 2010).

As mentioned in Chapter 1, the IPCC (2014) and World Risk Report (UNU- EHS, 2014) predicted that floods and typhoons will occur more often and that economic development and overpopulation in urban areas will exacerbate flood impacts in the future. The Philippines has a large population of 95M, 66% of which live in urban areas (UNDP, 2012; WB, 2012). Around 11.8M people reside in the capital Manila alone, while the population is expected to increase to 142M in year 2045 (PSA, 2014). Growth rates are 2.2% and 1.2% for urban and rural populations, respectively (UN, 2015).

Clearly, typhoons and floods are ongoing problems in the Philippines, which may threaten its economy and residents. Therefore, an examination estimating the *'value'* of flood prevention warrants attention in this country.

3.2. Criteria for selecting the case study area (The Metropolitan Iloilo)

My research focused on the Metropolitan Iloilo (MI) of the Philippines, an area in the Western Visayas Region that extends fifteen miles from north to south and another fifteen miles from east to west (total land area of 50,084 hectares) – see Figure 3.2. It is home to an estimated 740,000 people and for administrative purposes, is divided into seven districts, including a highly-urbanised centre (Iloilo City), which differs socio-economically from the other six administrative districts (Cabatuan, Leganes, Pavia, Sta.

Barbara, Oton and San Miguel). This area is a particularly appropriate place to empirically examine the aims of the thesis, as explained below.

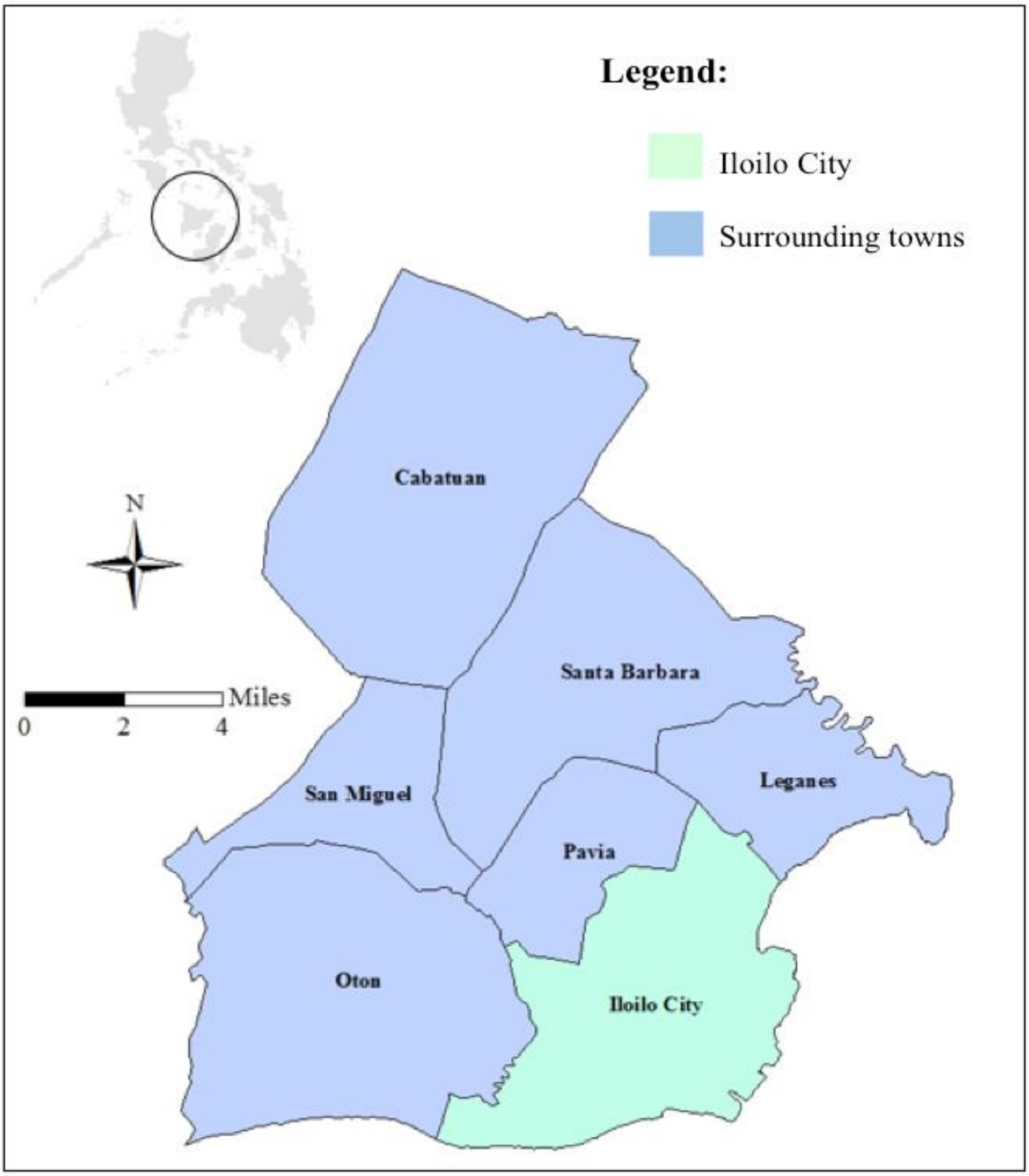


Figure 3.2: The location of the Metropolitan Iloilo (MI) in the Philippines (Map generated from GIS using PhilGIS data).

First, the area's climatic and topographic characteristics bring frequent rain all year. Table 3.2 shows the typhoons in the region from 2008 to 2012. It has three major rivers (the Iloilo, Jaro and Batiano rivers) and is adjacent to the coast (Iloilo-Guimaras Strait). Communities in MI and nearby towns also report frequent flood during heavy rains. Government officials cited high rainfall (95mm, in contrast to the normal rainfall of 55mm), low elevation level, unfinished drainage canals and extreme weather events as reasons for the flooding (Business World, 2014). In the case of households in Iloilo City, flood is also a problem because the city is: (1) 90% floodplain; (2) at a low elevation (2.63 metres above sea level); and (3) under continuous threat from damaged embankments and eroded lands and faulty drainage systems (City Planning and Development Office, 2011).

Table 3.2: Recorded typhoons in the Western Visayas region from 2008 to 2012.

Date	Typhoon (local name)		Date	Typhoon (local name)
April 2008	Neoguri (Ambo)		October 2011	Banyan (Ramon)
June 2008	Fengshen (Frank)		December 2011	Washi (Sendong)
September 2008	Hagupit (Nina)		August 2012	Kai-tak (Helen)
June 2009	Feria (Nangka)		July 2012	Saola (Gener)
September 2009	Ketsana (Ondoy)		September 2012	Sanba (Karen)
October 2010	Megi (Juan)		October 2012	Son-Tinh (Ofel)
August 2011	Nanmadol (Mina)		December 2012	Wukong (Quinta)
September 2011	Nesat (Pedring)		December 2012	Bopha (Pablo)

Source: OCD (2013) and PAG-ASA (2014).

Second, typhoons and floods adversely affect residents of the MI region. Recently, in July 2014, typhoon Neoguri (local name: *Florita*) caused flooding in the city that led to the cancellation of public school classes (Business World, 2014). At the household level, documented damages were recorded at almost a quarter of the affected communities' average annual household incomes (Subade, et al., 2014).

Damages have been recorded by various institutions. According to the OCD, the Western Visayas (WV) region incurred flood and flash flood damages of at least US$12.2M since 2011 (OCD, 2013).[13] Similarly, Figure 3.3 shows the number of typhoons and floods/flash floods that occurred in the Western Visayas Region between 2011 and 2013 and number of affected number of households affected (recorded by the OCD-Western Visayas). Furthermore, Appendix A summarises the vulnerabilities of sampled *barangays* (i.e. the smallest administrative units, also called communities or villages) to climatic disasters.

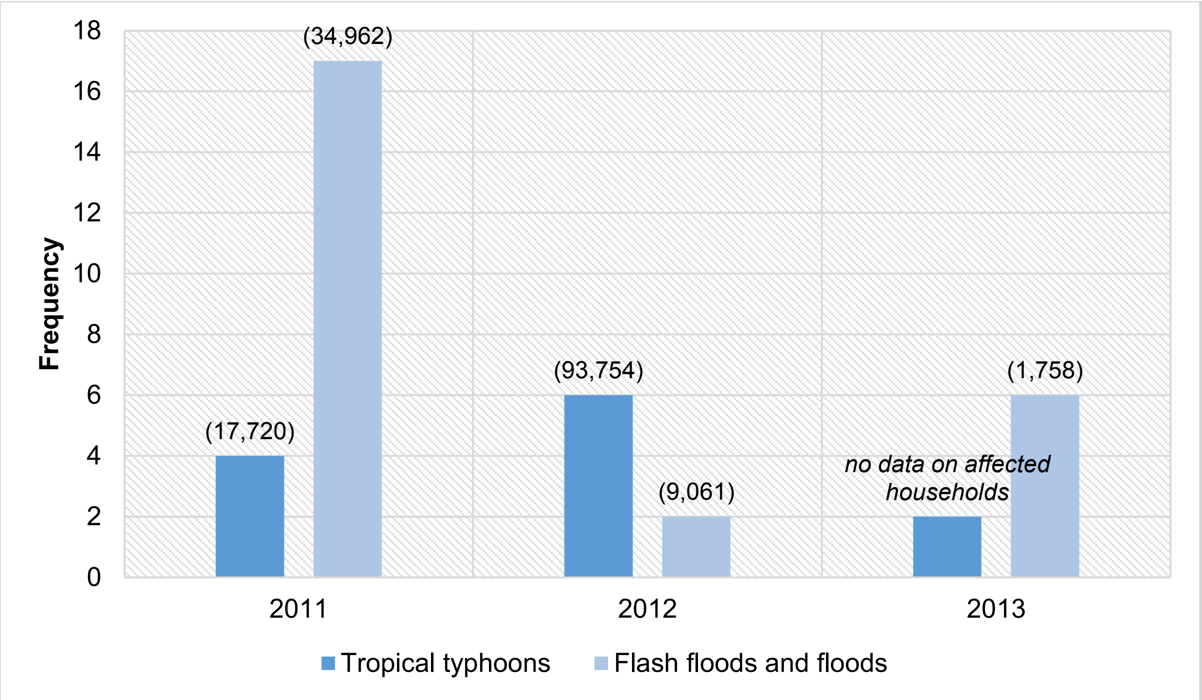


Figure 3.3: Tropical cyclones, flash floods and floods in Western Visayas Region.

Note: Number of affected households in parentheses, OCD-Western Visayas Regional Office. The OCD also recorded a sea mishap with TS Gorio that resulted in seven deaths and eight injuries.

In relation to the damages recorded above, diverse consumption and production activities in the region, particularly infrastructure and residential development, may also

[13] Exchange rate at US$1 = ₱45 in 2015.

have adversely affected forests/watersheds, rivers and other ecosystems, which has increased the region's vulnerability to flood damage (Penuela, 2008; City Planning and Development Office, 2011). The sewerage system in the region is non-existent and waterways are silting. As flood hazards become worse due to these activities, hundreds of families residing near rivers are frequently affected and evacuated because of persistent rain and flooding during the rainy season in recent years (NDRRMC, 2014; OCD, not dated).

Third, the MI consists of urban and rural *barangays* – making it possible to compare and contrast findings across different types of households. That is, typhoons and floods affect industries differently. Similarly, there is a wide cross-section of income groups in the area – allowing one to examine flood impacts and responses to survey questions in rich and poor households. The towns are classified into income classes, where a first class municipality has an annual town income of more than US$1,229,057 (₱55M) and a sixth class municipality has less than US$335,389 (₱15M). Notably, residents of the MI region also work in a range of different industries, with rural and coastal communities largely dependent on agriculture and fisheries; whereas residents of Iloilo City and Oton are mostly employed in commercial industries, particularly in retail (DILG, 2010). As such, I was able to explore the extent to which flood impacts differ across households, which are dependent upon different industries for their income and livelihoods. Table 3.3 summarises the towns and city in the MI and their corresponding socio-demographic profiles.

Lastly, mismanagement of disaster-related projects in local governments may have resulted in ineffective flood-reduction strategies. This claim is evident in the Philippines and in the MI region. Under the Philippine Disaster Risk Reduction and Management

Act of 2010, local governments are mandated to strengthen their capacity to address disasters through participatory and collaborative approaches. However, disaster risk management (DRM) in the country focuses mainly on preparedness and response (e.g. evacuation and shelter) and its institutional framework has not been properly implemented (e.g. investment and development plans) (Benson, 2009). For instance, as of 2006, around 1,106 municipalities (out of 1,500) and 80 cities (out of 117) had established their respective Disaster Coordinating Councils (DCCs), some of which were non-functional. Recently, however, programs became more innovative, such as implementing activities such as collaboration with private sectors and other institutions (Benson, 2009; City Planning and Development Office, 2011; Suyo, Prieto-Carolino, & Subade, 2013). Thus, I chose to focus on this region in this thesis.

Table 3.3: Demographic and socio-economic profile of the Metropolitan Iloilo in the Western Visayas Region, Philippines.

City/ Towns	**Area (hectares)**	**Headcount**	**Household population**	**No. of *barangays***	**Major industries**	**Income class**	**Annual income (in ₱)**
Iloilo City	7,834	437,366	96,049	180	Commercial and Service Centres; Industrial	1st class city	1,374,928,617
Pavia	2,703	46,765	9,655	18	Industrial; Commercial and Service Centres	2nd class	86,320,391
Sta. Barbara	13,196	54,166	14,140	60	Agricultural; Industrial	2nd class	14,952,410
Oton	8,644	82,572	17,315	37	Agricultural; Fishery	1st class	127,522,201
Leganes	3,220	29,438	6,191	18	Agricultural; Commercial and Service Centres	4th class	59,964,121
San Miguel	397	25,561	5,306	24	Agricultural; Commercial and Service Centres	2nd class	50,762,752
Cabatuan	11,290	56,910	11,821	68	Agricultural; Commercial and Service Centres	2nd class	83,333,738
MI region	*47,284*	*732,778*	*160,477*	*405*			*1,797784,230*

Source: DILG (2010).

3.3. Disaster legislation and spending in the Philippines

This section introduces the key elements of disaster management in the Philippines and provides background information on disaster legislation and spending.

Disaster management involves various activities, such as mitigation, preparedness, rehabilitation and response (Figure 3.4). Legally, the disaster management system of the Philippines is supported by the Presidential Decree 1566 (PD 1566) of 1978.

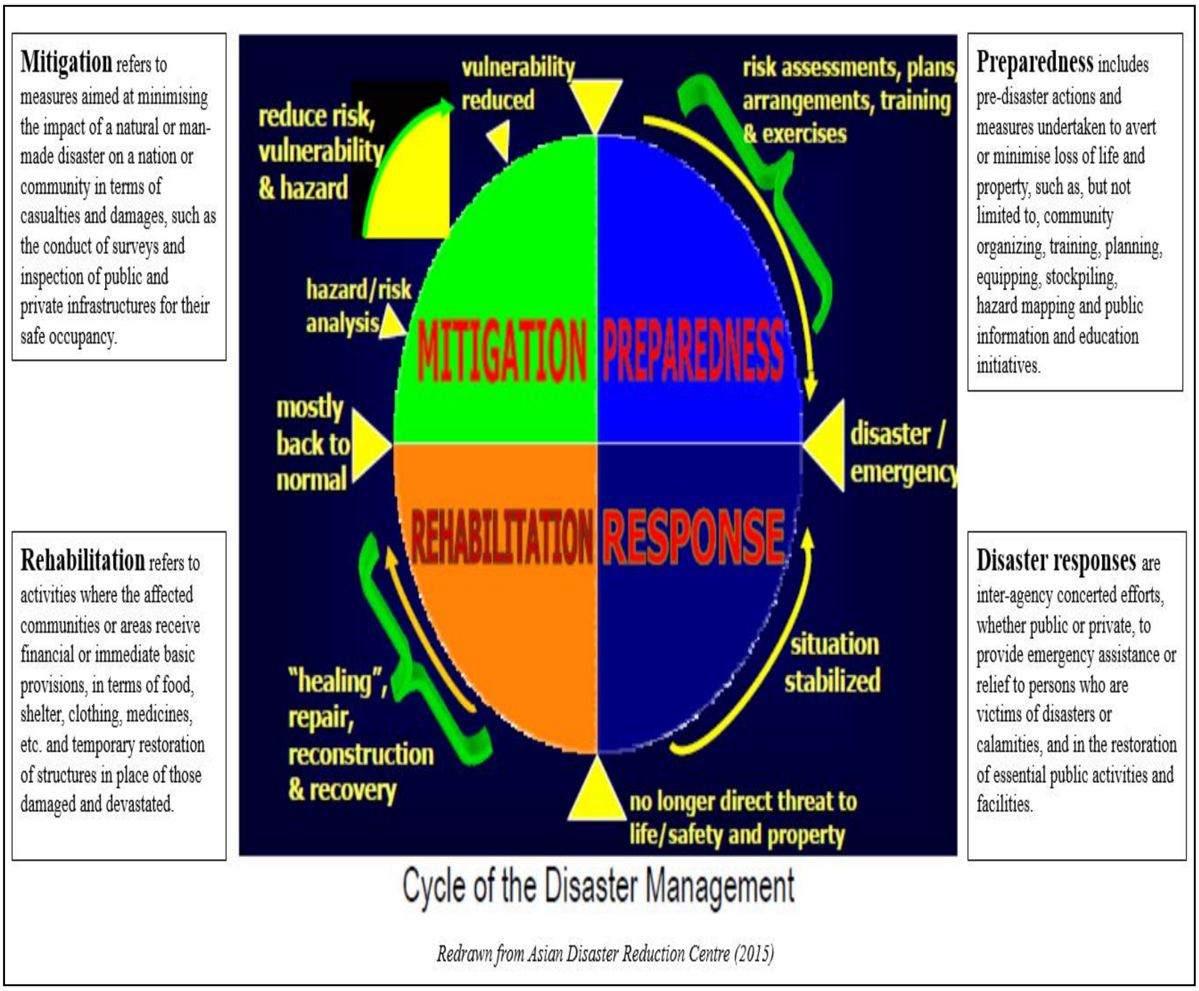


Figure 3.4: The disaster management cycle.

The National Disaster Risk Reduction and Management Council (NDRRMC), which consists of national department and non-government institutions, serves as the leading body that manages disasters in the country. Figure 3.5 depicts the organisational structure and composition of the NDRRMC.

It is clear from the structure that four vice chairmen represents the four elements of the disaster management cycle from four government departments. Lower administrative levels are also mandated to establish their own DCCs (Delfin & Gaillard, 2008): regional (Regional Disaster Risk Reduction and Management Council or RDRRMC); provincial (Provincial Disaster Risk Reduction and Management Council or PDRRMC); city/municipality (City/Municipal Disaster Risk Reduction and Management Council or C/MDRRMC); and *barangay* (Barangay Disaster Risk Reduction and Management Council or BDCC). The DCCs coordinate the disaster related activities to/from their respective units to the national government to ensure efficient delivery of services, especially in times of disaster emergencies.

It is also interesting to note that the country's disaster legislation is multi-sectoral, as it recognises municipal and barangay levels in disaster risk reduction management (Manyena et al., 2013). At a national level, the government is signatory to international disaster management guidelines (i.e. Hyogo Framework for Action and later the Sendai Framework for Disaster Risk Reduction). There are also various climate change mitigation policies at the regional level, such as the Iloilo Flood Control (approved loan amount for Phase I and II: US$61M) and the Panay River Flood projects (US$80.6M) (Lasco et al., 2009; JICA, 2013).

At the local level, Iloilo City has a Comprehensive Land Use Plan (CLUP), an instrument that allows emergency response measures to communities. Post-disaster (flood) measures, such as relief operations, are also institutionalised in the region (Iloilo City Government, 2011). I provide a summary of the legislation adopted in the Philippines and in the MI area, as well as international laws ratified by the Philippine government (Appendix B). From this summary, I deduced that the national-level legislation is in place but not at the town/municipality-levels. The Local Government Units (LGUs) seem to have a less proactive role in preventing flood damages. This argument is supported by a comprehensive study by Benson (2009) on disaster and climate change mainstreaming in the Philippines.

Disaster programs and activities can be funded and/or provided in various ways. For instance, financial budgets can be drawn from the following: (1) General Appropriations Act (GAA) – through the existing budgets of the national line and government agencies; (2) National Disaster Risk Reduction and Management Fund (NDRRMF); (3) Local Disaster Risk Reduction and Management Fund (LDRRMF); (4) Priority Development Assistance Fund (PDAF); (5) Donor Funds; (6) Adaptation and Risk Financing; and (7) Disaster Management Assistance Fund (DMAF). Resources are also available from the following: (1) Community-based good practices for replication and scaling up; (2) Indigenous practices on DRRM; (3) Public-Private-Partnerships; and (4) DRR and CCA networks of key stakeholders.

Attention is given to the local calamity fund, which is a mandatory fund allocated by the LGU from their annual budget and is equivalent to 5% of their estimated income as mandated by Republic Act (RA) of 1556 and Local Government Code (LGC) of 1991 (Benson, 2009). This fund is tapped if the LGU declares a *'state of calamity'*, adhering to the following criteria: (1) at least 20% of the population are affected and need assistance, or 20% of all dwellings have been destroyed; (2) at least 40% of livelihood means, such as outrigger boats, vehicles and the like, are destroyed; (3) major roads and bridges are destroyed and impassable for at least a week; and (4) widespread destruction of crops, fishponds, poultry and livestock and other agricultural products (Delfin & Gaillard, 2008, p. 192). The current legislation is restrictive in terms of allocating flood prevention at local levels (Benson, 2009);

which may lead to lack of political will managing floods or other disasters from local politicians.

Similarly, there have been records of (relief and humanitarian) NGOs (Luna, 2001; Cancellar & Hipolito, 2011; Cadag & Gaillard, 2012) assisting various communities (e.g. citizen-based organisations, faith groups, etc.) with community-level disaster management. This is seen to be more effective in some communities in the Philippines (Luna, 2001; Gaillard & Cadag, 2009), and in other poor regions in the world (Shaw, Pulhin, & Pereira, 2010), because workers and members of NGOs are front-liners in disaster responses (e.g. the first ones to respond and to assess damages) and are significantly impacted by disasters (Delica-Willison, 2004; Cancellar & Hipolito, 2011). Luna (2001) and Cancellar and Hipolito (2011) discussed involvement of NGOSs in community-based disaster management, which includes organising and capacity building, advocacy, and *'influencing jurisprudence for disaster prevention.'*[14] On the other hand, around 43% of the families in Sagrada, Philippines, built bridges to protect themselves from floods (Gaillard et al., 2008). It was also documented that in order for Filipino households to adapt to flooding, 72% of them save food for the duration of the flood.

In summary, my thesis provides information for governments, particularly local policy makers (i.e. in LGUs, including the city council). There is evidence of impacts of floods and other disasters, which the government recognises. There are legislation and flood prevention programs in place but the key policy question is *how much should they be spending*. This information is crucial, particularly in making choices about allocations between flood and other disasters or between disaster management areas (e.g. prevention versus rehabilitation).

[14] The LGUs in the MI area have limited documentation of NGOs' involvement, so I do not have any information of their participation.

My thesis looks at one category of disaster management, prevention, which emphasises expenditures on how to prevent or minimise flood risk (e.g. structural prevention).

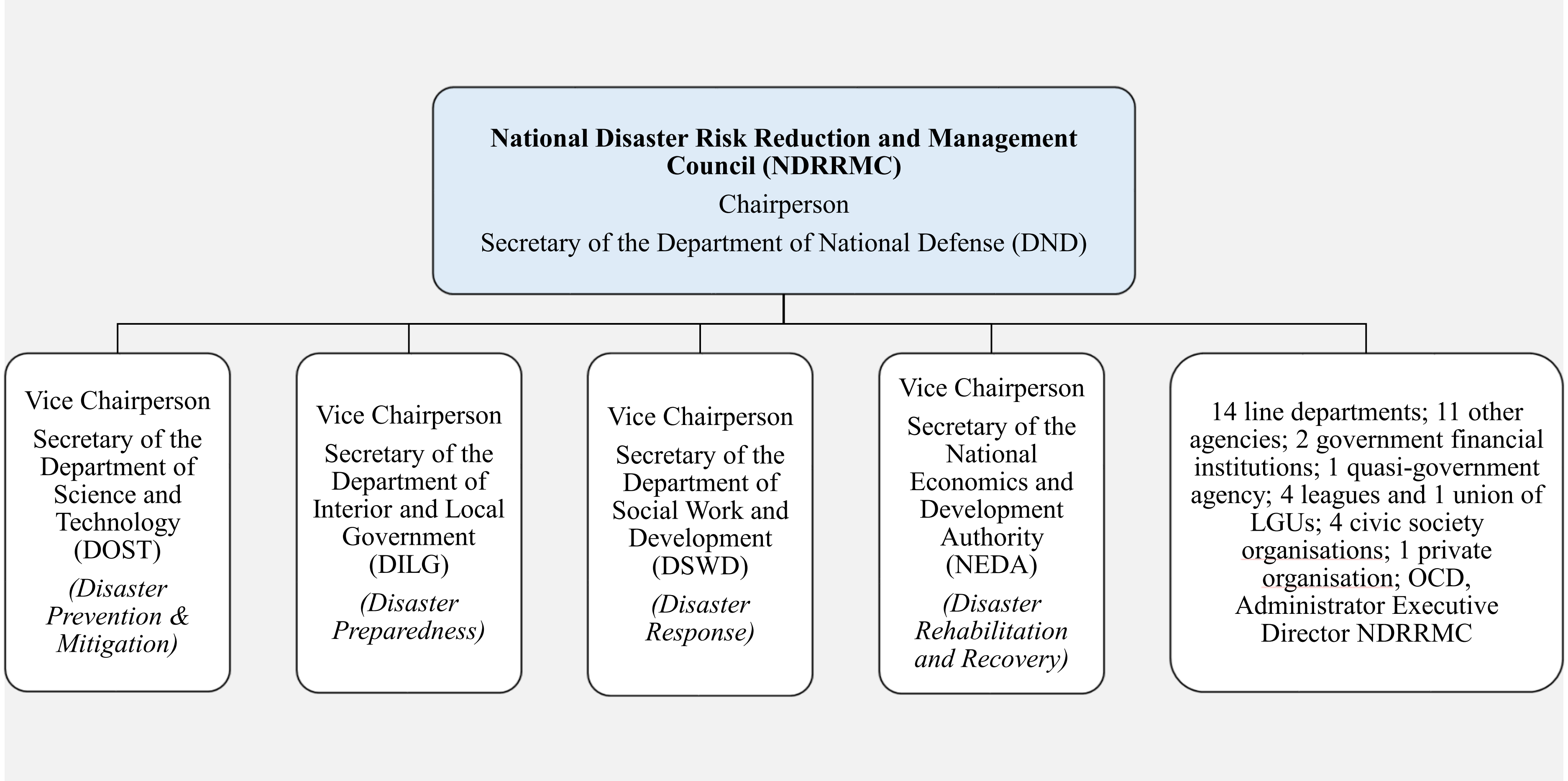


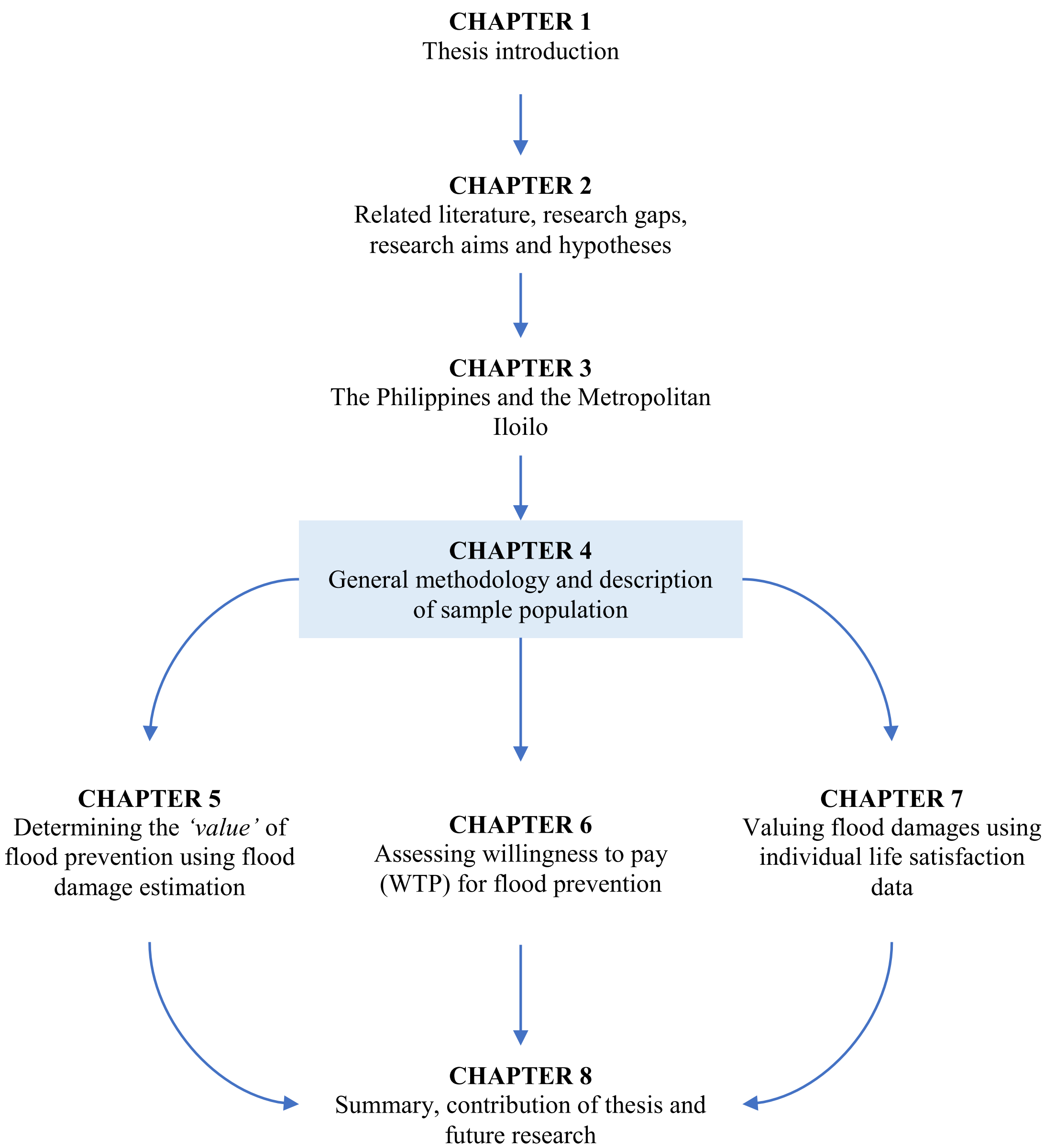
Figure 3.5: The disaster management system in the Philippines Redrawn from Asian Disaster Reduction Centre (ADRC, 2015).

3.4. Chapter summary

This chapter presented the case of the Philippines as an interesting area for investigation of flood damages, WTP and LS. The country is one of the most vulnerable in the world, in terms of disaster impacts and exposure; recently ranking second in terms of disaster risk by the World Risk Report. The flood impacts will likely worsen in the future according to the IPCC; where residents in low-lying urban and surrounding areas and those who are socially disadvantaged will be affected more. Therefore, an investigation of flood impacts and the corresponding expenditure on flood prevention warrants attention in the Philippines.

There are four main points as to why the Metropolitan Iloilo (MI) area is an appropriate case study area in the Philippines: (1) the residents experience frequent typhoons and floods every year; the area is bound by a coast whilst rivers and creeks spread throughout the region; (2) flood impacts the regional economy and its residents; (3) there are varying levels of impacts from floods because of varied industries and because of households with a wide-cross section of income and other socio-demographic characteristics; and (4) ineffective flood-reduction strategies have been observed in this area, particularly mismanagement of disaster-related projects in local governments.

Thesis outline



4: General methodology and description of the sample population

Chapter outline

Chapter 4 aims to: (1) present the development and design of the questionnaire; (2) explain the execution of the household surveys; and (3) describe the sample population. This chapter introduces the general methods used to answer the research questions presented in Chapter 2 and starts by describing the ethical requirements of the research. The second section presents the development of the research instrument, which comprised a rigorous process involving: literature review, focus group discussions, pre-test surveys and questionnaire translation. Subsequently, the third section presents the household survey implementation while the final section describes the sample population.

4.1. Ethical considerations

Prior to data collection, an official ethics application was submitted to the James Cook University (JCU) Human Research Ethics Committee for assessment for appropriate conduct of research. Approval to conduct data collection between November 26, 2012 and December 31, 2015 was obtained, subject to informed consent of all participants and anonymity of the participants to protect their privacy (Ethics Approval Number - H4875, Appendix C). During the research, all participants gave consent to participate, after informing them about the study and the use of collected data. Most of them gave written consent and those who could not write (or preferred not to sign) gave verbal consent. No names were used in the processing of data or on the research outputs; instead respondents were described by their socio-demographic characteristics or other generic attributes.

4.2. Questionnaire development

Most research on well-being in economics has used secondary data to obtain information on environmental losses. Its use may be problematic because of a scaling mismatch between self-reported LS and secondary environmental data (also discussed earlier in Chapter 2). I needed household specific information about flood damages (FD), willingness to pay (WTP) for flood prevention and life satisfaction (LS), in addition to other information known to influence both WTP and LS. This type of data is not available from secondary sources, hence the need to collect data via survey.

I took three broad steps to formulate the final questionnaire:

1) I reviewed the literature to gain insights about variables that are likely to be important. Specifically, factors were identified from other studies and summarised into lists of factors influencing WTP and LS. These factors have been presented and discussed in Section 2.3 for WTP and Section 2.4 for LS.
2) I used insights from the literature review to develop questions for use in focus group discussion (FGDs). The three main objectives of the FGDs were to: (1) understand the concept of *'life satisfaction'* of residents in the case study area; (2) determine regionally relevant and measurable determinants of overall LS for inclusion in the questionnaire; and (3) identify a realistic scenario for the contingent valuation (CV). The last objective specifically aimed to: (A) identify relevant environmental problems in the region; and (B) gather relevant information for the hypothetical scenario (e.g. payment duration, payment card intervals/divisions and trusted institutions and ways to handle these payments).
3) I used insights from the FGDs (Section 4.2.1) to develop a pre-test survey to ensure that the instrument used words and scenarios appropriate for the case study area.

Details relating to the FGDs and the pre-test are given below.

4.2.1. Focus group discussions (FGDs)

Morgan (1997) defined focus group discussion (FGD) as a group interview that allows *“the use of group interaction to produce data and insights that would be less accessible without the interaction found in a group”* (p. 4). Given that my focus was to investigate relevant environmental problems and well-being in the Metropolitan Iloilo (MI) region, FGD is appropriate.

Marshall and Rossman (2011) reported that an effective FGD should include 4-8 participants, which would allow interaction between different profiles of respondents. I was particularly interested in a sample of participants who represent the variety of residents in terms of occupation, level of exposure/experience with regards to the environment and socio-demographic characteristics. Therefore, participants were selected based on the following criteria:

1) Have demonstrated interest in discussing their overall LS and environmental problems in their neighbourhood and region;
2) Have resided in Guimaras (rural), in Iloilo City or its surrounding towns (urban and sub-urban areas); and
3) Have been employed in one of various sectors of employment (service, industrial, agriculture/forestry/fisheries and tourism).

Snowball sampling was implemented to recruit participants. At first, personal networking was used to identify residents and the recommendations of who to contact next were based on these initial contacts. Since the success of FGDs depends on the availability and willingness of participants, I asked for assistance from the *barangay* councils with regards to recruitment. To control for bias of recommendations of individuals who are educated or pro-*barangay*/village or other government institutions, I specifically asked for residents from the private sector or who were not affiliated with the government. I invited 8-10 participants per discussion, although only 3-5 attended each meeting. Those who did not make it to the FGD reported that they had to attend to something important in lieu of the FGD.

I facilitated the discussions at various locations: (1) the Provincial Capitol in Guimaras, (2) Guimaras State College, (3) Barangay Hall of Desamparados in Iloilo City and (4) the University of the Philippines Visayas – Iloilo City Campus, between December 2012 and January 2013. Each discussion lasted for 1 to 1 hour and a half. Refreshments and transportation costs for participants were covered by the research.

In total, 19 individuals from Iloilo City and Guimaras participated in six FGDs that were conducted as shown in Table 4.1. Out of 19 participants, few individuals work in the tourism sector (10.5%). Participants from the service (31.6%), industrial (26.3%) and agriculture (31.6%) sectors were distributed evenly. Around 84.2% of participants were 31 to 50 years old and the rest older than 50 years old (15.8%). Most participants who attended were female (73.7%).

All of the questions in the FGDs were open-ended, in order to allow the discussants to elaborate on their answers and to identify issues that were not novel (Morgan, 1997; Veal, 2006). The discussions were done in Hiligaynon (the local dialect). Participants were also allowed to respond in either English or Hiligaynon, so I prepared FGD materials in both languages. There was no problem with regards to translating from English to Hiligaynon (or vice versa), as Hiligaynon is my first language. The English versions of the questions guide for FGD is provided in Appendix D while the corresponding research brief and informed consent form are shown in Appendix E and Appendix F, respectively.

Table 4.1: Summary profile of focus group discussion participants.

Profile of participants	Frequency (%)
Sectors of employment	
Service (including retail)	6 (31.6%)
Industrial	5 (26.3%)
Agriculture (including fisheries and forestry)	6 (31.6%)
Tourism	2 (10.5%)
Age	
31-40 years old	8 (42.1%)
41-50 years old	8 (42.1%)
51-60 years old	3 (15.8%)
Gender	
Female	14 (73.7%)
Male	5 (26.3%)
Total participants (total no. of FGD = 6)	19 (100%)

The FGD consisted of four parts. The first part was focused on residents' opinions about LS, while the second part was about the factors that may influence it. Perceptions about their environment, particularly in their neighbourhoods and in the region, were discussed in the final part of the discussion. I discuss the details in the section below.

4.2.1.1. Discussions about what 'life satisfaction' means in the Philippines

As mentioned in Chapter 2, the study of LS has been done in various disciplines and the terms used have been inconsistent (e.g. '*quality of life*', '*overall satisfaction with life*' or '*life contentment*'). Therefore, it was one of my primary aims to understand more about the terminology and the possible overlapping meanings when the context is discussed in the Philippines.

In the beginning of each FGD, I introduced myself and my research to the participants and gave them a background about life satisfaction and the known factors that affect it, with the help of photographs (e.g. infrastructure, money, family, etc.) (Copyright permission of photographs in Appendix G).

One of the first points of discussions was their opinion about the terms, '*quality of life*', '*overall satisfaction with life*' or '*life contentment*' and their associated words/phrases. Most of the participants expressed the belief that '*overall satisfaction with life*' or '*overall life satisfaction*' were similar. The term '*happiness*', according to them, was '*narrow*' and '*short*'. Participants also did not associate the term '*quality of life*' to any of these terms, in contrast to the interchanging use in the literature (as discussed in Chapter 2).

*4.2.1.2. Discussion s*about the determinants of life satisfaction

There are many determinants of LS; in particular, I discussed various types of capitals that influence it (recall Table 2.5 in Chapter 2). As the second point of discussion, I asked the participants to list factors that contribute to their overall satisfaction with life. At this time, I also asked if some of the identified factors were associated with each other, or go well together. If this was the case, participants may group these factors together and subsequently give a brief explanation as to why the groupings came about. This exercise allowed me to minimise the redundancy of questions on the survey instrument later.

Some determinants may also influence LS more than others (Larson, 2010; Fujiwara & Campbell, 2011). Following this argument, I gave participants five sticker dots and asked them to distribute these dots to previously identified factors. These dots represented levels of importance; for example, two dots would mean more important than one dot. I also instructed them that it is possible to allocate all dots to one factor. Figure 4.1 shows some of outcomes from this discussion. In this example, Participant A responded in Hiligaynon and listed two factors, while Participant B responded in English and listed four factors. Both of these participants allocated dots differently.

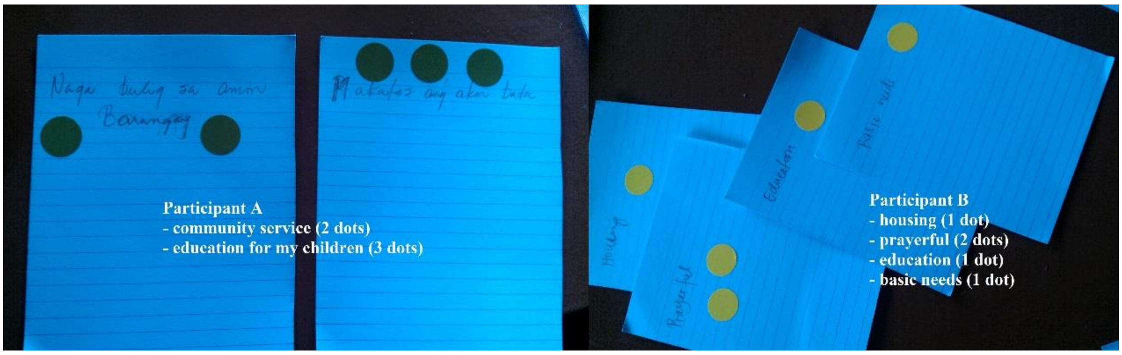


Figure 4.1: Sample responses of FGD participants on determinants of their overall life satisfaction.

A summary of the determinants of LS and the corresponding level of influence, as denoted by the number of allocated sticker dots, is shown in Figure 4.2. Results showed that employment (15), income (11) and family relations (9) mostly influenced participants' life satisfaction. Also important were helping the community, health, religion, education, location/neighbourhood (e.g. secured and less polluted), road condition and respect. As expected, these factors reflect and coincide with the various types of capitals listed in the initial review of literature (recall Table 2.5 in Chapter 2).

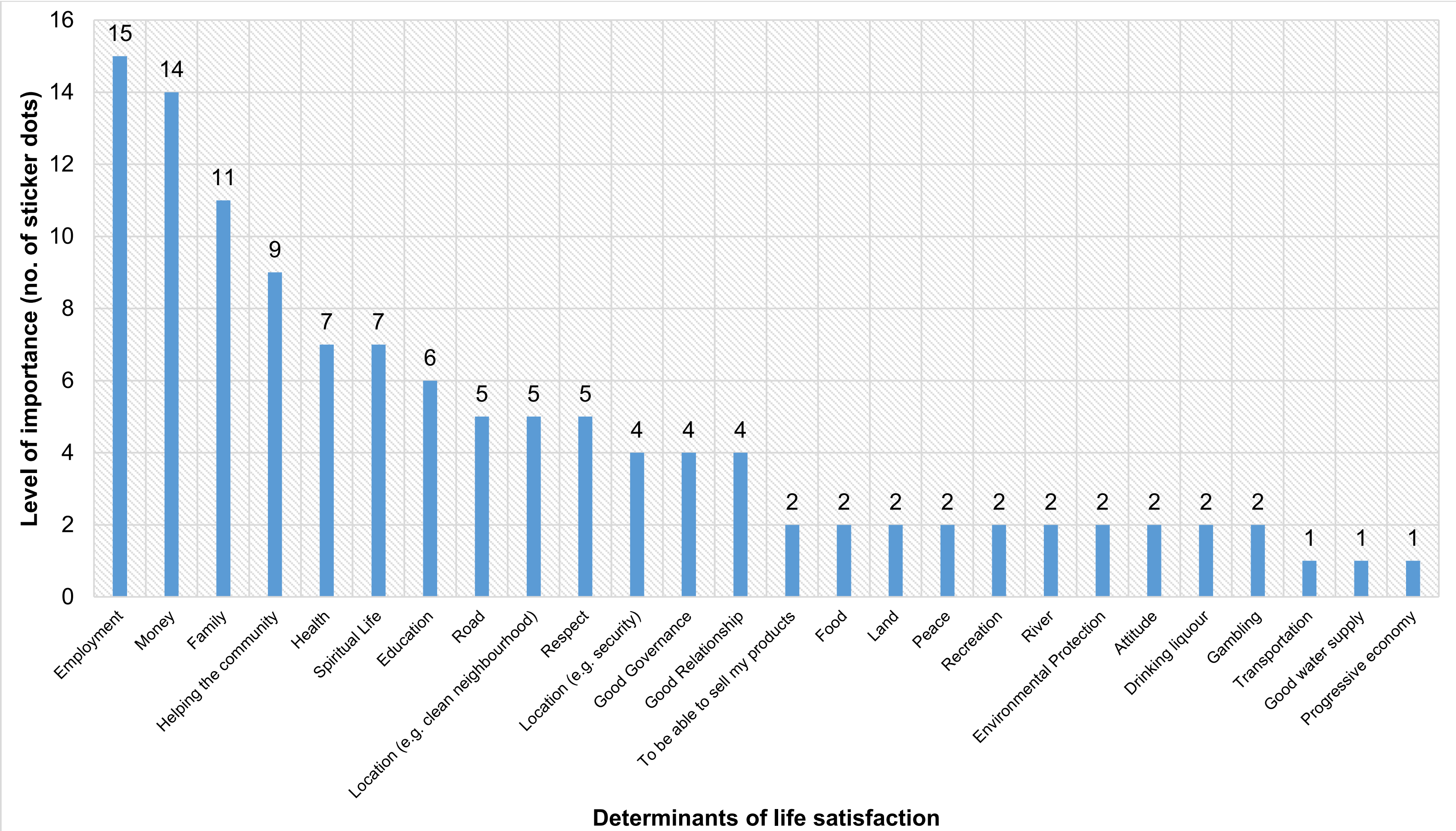


Figure 4.2: Level of importance of factors affecting overall life satisfaction - according to FGD participants.

4.2.1.3. Identification of regionally relevant environmental problems

As discussed in Chapter 3, the MI region is confronted by many environmental problems, which are potential study topics. I wanted to focus my thesis on the most relevant problem. The third point of discussion in the FGD followed this argument by asking them about environmental problems in participants' neighbourhood and in the MI area. I also allowed them to identify and discuss possible solutions to these problems.

Table 4.2: Regionally relevant environmental problems.

Environmental Problems (ranked from most problematic to least problematic)	Proposed Solutions
1) Flood (e.g. in rivers/creeks)	Proper implementation of regulations, drainage, barriers
2) Natural disasters	Awareness/preparedness seminar
3) Garbage (especially in land and river)	Fix drainage or install drainage in some areas
4) River pollution	Regular river clean-up, dredging, educating people about environmental policies and costs of pollution
5) Solid waste	Seminar on solid waste management with the assistance of LGU; exercise composting in households
6) Mining and *kaingin* (slash and burn)	Being vigilant, tree planting
7) Illegal logging	Proper implementation of permit/regulation of tree cutting

Out of the seven problems identified and discussed, natural calamities (including flood and typhoons) and pollution (solid waste and river pollution) were rated as most problematic (Table 4.2). During our discussions, some participants alluded to the notion that the top four problems were related. For instance, in the discussion about flood, participants often associated this problem to natural disasters (e.g. typhoons) or to polluted rivers. Participants also noted that governments should properly implement regulations relating to disasters, such as, installation of water barriers and proper information dissemination in order to minimise impacts from flood and natural disasters.

These results were not surprising. It is well documented that communities and individuals are impacted through damage of property, interruption of employment and livelihood generating activities and spread of diseases, such as typhoid and diarrhoea (Zoleta-Nantes, 2002). In September 2006, typhoon Xangsane (local name: *Milenyo*) caused damage valued around US$134M and US$83M to property and agriculture, respectively (Lasco et al., 2009). More recently, initial estimates from typhoon Haiyan (local name: *Yolanda*), which struck in November 2013, are around US$417M for infrastructure and another US$417M for agriculture damage (NDRRMC, 2014).

4.2.1.4. Derivation of acceptable payment vehicle and institution, payment card divisions/intervals and duration of payment

In Chapter 2, I noted that *'scenarios'* are essential in CV studies. In particular, one needs to carefully specify: (1) the environmental goods to be valued; (2) the appropriate payment vehicle; and (3) the frequency and duration of payments. With the payment card (PC) approach, where respondents were given a set of amounts to choose from, I needed information about how many options to include and what ranges of these amounts to use.

In this stage, I asked for an open-ended WTP (Figure 4.3), in order to give validity to the payment card (PC) option later in the main survey. Research indicates that respondent choices can be influenced by the number of divisions presented to them in their PC, as well as the prices presented to them (Farr, Stoeckl, & Beg, 2014; FAO, 2015). As such, it is important to ensure that the ranges of prices presented to respondents are *'realistic'*, given the demographics of the study area. Therefore, in the final survey I adopted a PC option for the CV format, which asks the amount respondents would be willing to pay, in which they select from amounts listed on the questionnaire (Cameron & Huppert, 1991; Håkansson, 2008).

To acquire all this information, I presented a scenario where there would be a project/program that minimised the impacts of the environmental problems they discussed in the beginning of the FGD (as depicted earlier in Table 4.2). I subsequently asked for their household's WTP for each of the environmental problems they had previously identified.

Imagine if the fund will be raised, your household will be asked to donate to this fund. What is the maximum amount (in ₱), you would be willing to pay for each of the following problem/threat to the natural environment.

When answering, consider your household's income and expenditure.

	Money donated _______													
	₱ 0	₱ __	₱ __	₱ __	₱ __	₱ __	₱ __	₱ __	₱ __	₱ __	₱ __	₱ __	₱ __	More than ₱____
Problem/ Threat #1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐How much? ₱ _______
Problem/ Threat #2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐How much? ₱ _______

Figure 4.3: The payment card question used during the focus group discussions.

Results are shown in Figure 4.4.[15] Clearly, most respondents were willing to pay around ₱20; however, there were also a considerable number of respondents who would be willing to pay more than ₱10,000 (14%). It can be observed that most people indicate amounts ₱100 to ₱1,000 and below ₱20. This implies that I should

[15] Since there are seven environmental problems presented, the total frequency on the table is not equal to the number of participants (i.e. n=19).

include values in between these amounts in the final set of intervals, in order to capture variation. The amounts were used to develop the interval of the payment card in the survey. The final set of interval amounts comprised of the following: ₱0, ₱2, ₱3, ₱5, ₱10, ₱15, ₱20, ₱30, ₱50, ₱100, ₱200, ₱500, ₱1000 and more than ₱1,000.

In addition, I asked the participants about the acceptable number of payment times (i.e. frequency of payment), the type of payment (donation or compulsory) and the trusted institution to manage the funds. According to them, an acceptable payment for *'small amounts'* would be monthly or weekly, but for *'large amounts'*, yearly. Payments should be voluntary and the *barangay* council should be the one to manage the funds, for the reason that the councils work closely with the residents and, therefore, is mostly accepted and trusted. A summary of these discussions is shown in Table 4.3.

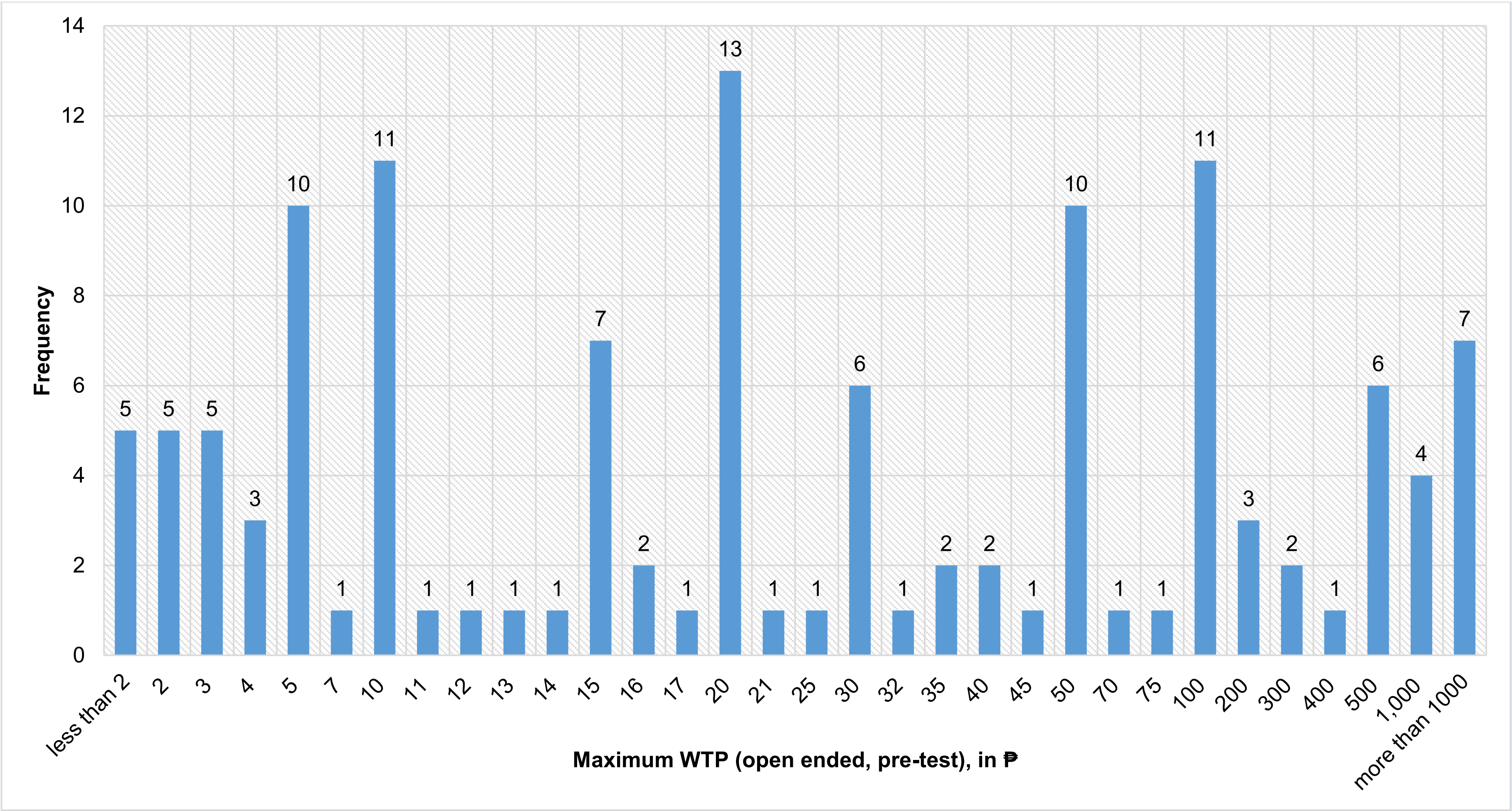


Figure 4.4: Maximum willingness to pay (WTP) of respondents during the focus group discussions.

Table 4.3: Information for the CV scenario: payment duration, payment type and trusted institution.

FGD no.	Payment frequency		Payment type	Recommended institution to handle payment
	'small amounts'	*'large amounts'*		
First	Every month	Yearly	Donation	Barangay
Second	Every week	Yearly	Donation	Barangay
Third	Every month	Yearly	Donation	Barangay
Fourth	Quarterly	Yearly	Donation	Barangay
Fifth	Twice year	Yearly	Donation	Barangay

The findings above have been deliberated during the FGDs, so the items, presented in the table correspond to the consensus choice of participants. This information was used to construct the CV scenario, where the more popular choice of payment frequency is every year, payments type is household donation and most trusted organisation is the *barangay*.

4.2.1.5. Summary of FGD outcomes and amendments of survey questionnaire for the pre-test survey

The FGDs were set out to understand more about the concept of *'life satisfaction'* and other associated terms as well as to identify key information for the CV hypothetical scenario. Key findings are listed below:

- The term *'overall life satisfaction'* seemed to coincide with a measure of well-being that is not temporary and the term was also interchangeable with *'satisfaction with life'* and *'life contentment.'* From here on, I used the term *'overall life satisfaction'* in referring to subjective well-being i.e. self-reported life satisfaction.

- LS depends on a range of capitals, but most important were factors relating to financial capital (e.g. money and employment), location (e.g. road condition, secure and unpolluted community and helping the community) and one's self (e.g. family, religion, health and respect).
- Pollution (solid waste) and flood were the most relevant problems in the MI area and residents were willing to pay (positive WTPs) to minimise impacts from these problems.
- Results from the open-ended WTP were used for development of the payment card option in the final survey. The most-cited amounts were used for the intervals. But, I also included amounts below ₱20 and above ₱100 because of the variation of answers for these ranges.
- The WTP amount depended on whether the payment was voluntary *'small amounts'* and whether the payment was handled by the *barangay* (community) council. Yearly contribution was most acceptable. Donations were consistently selected as the preferred payment vehicle (respondents were adamant that they did not want to pay more taxes or extra charges on their water or electricity bills) and the '*barangay hall'* (community council) was identified as the most trusted institution.

Using these outcomes, I revised the survey instrument for comprehension and clarity, especially with regards to questions about LS and for more realistic hypothetical scenarios to measure WTP. A pre-test household survey followed the FGDs and its execution is discussed in the next section.

4.2.2. Pre-test survey

Denzin (1970) suggested that pre-test surveys require a small group of respondents who are similar to the population in the main survey. The pre-test questionnaire was in Hiligaynon and served as a pilot test for the main household survey. I used insights from the pre-test survey to further refine the questionnaire (final sections of the questionnaire are discussed in Section 4.3.1).

The pre-test was specifically designed to:

1) Test whether face-to-face interviews or drop-off and retrieve (self-completed) questionnaires were more effective;
2) Test the payment intervals derived from FGDs;
3) Identify an appropriate payment vehicle and *'trusted'* institution to manage the payments; and
4) Determine if the questions were clear and understandable and if the wording was appropriate.

4.2.2.1. Pre-test sampling

The sampling design was formulated to match the aims of the pre-test survey. Fifty questionnaires (50) were distributed to residents from various communities in the MI area (Iloilo City, Sta. Barbara, Cabatuan, Pavia, Oton, Leganes and San Miguel) - Table 4.4. I also included communities from the nearest island province of Guimaras, in order to get a sample from rural communities, as the province is mainly agricultural. With this sampling design, the sample includes residents with a variety of socio-demographic characteristics and with different exposure to environmental problems, due to their locations (e.g. coastal area versus land-locked).

I purposively selected the *barangays* in each town/city, most of which were identified from previous acquaintances from the FGDs. Once the *barangays* were selected, I acquired a list of households from the Barangay Health Worker (BHW) and randomly selected one respondent and two alternative respondents (in cases where the first respondent was not available or refused to participate).

Table 4.4: Distribution of pre-test survey respondents.

Location	**Total number of respondents (=50)**	**Survey method**	
		Drop-off Approach (=25)	**Personal Interview (=25)**
Rural areas (34%)			
Buenavista, Guimaras	3	2	1
San Lorenzo, Guimaras	5	1	4
Sibunag, Guimaras	4	3	1
Nueva Valencia, Guimaras	2	1	1
Jordan, Guimaras	3	2	1
Iloilo City and its surrounding areas (66%)			
Desamparados, Iloilo City	4	2	2
San Vicente, Iloilo City	1	0	1
Arevalo, Iloilo City	1	1	0
Rizal, Iloilo City	2	1	1
Aduana, Iloilo City	2	2	0
Daga, Sta. Barbara	4	1	3
Morobuan, Cabatuan	4	0	4
Anilao, Pavia	4	2	2
Buray, Oton	3	2	1
Trapiche, Oton	1	1	0
Guihaman, Leganes	4	2	2
Barangay 10, San Miguel	3	2	1

Two data collection approaches (self-administered survey using a drop-off approach and personal interview) were tested for effectiveness. Effectiveness is defined here as ease of conducting the survey and the response rate. The former is a method in which a surveyor randomly selects residents, introduces themselves and the study, leaves a survey kit including a self-administered questionnaire to be completed by the respondents, arranges for a pick-up in the next two or three days and returns to retrieve the completed questionnaires (Francisco, 2010, p. 10). The latter involves a face-to-face interview with respondents. Subade (2005), in his CV study on the Philippine Tubbataha Reefs, found that a drop-off approach yields a high return rate of completed questionnaires, is less prone to interviewer bias and less expensive than face-to-face interviews.

I randomly assigned a data collection approach per questionnaire: 25 respondents were personally interviewed while the rest were surveyed using the drop-off approach. The pre-test survey was conducted from February 24th, 2013 to March 2nd, 2013 with the help of two hired enumerators.

I looked at the responses from the pre-test survey and had a discussion with the enumerators. The interviews only lasted up to 20 minutes and respondents did not seem to be saturated with the questions. The face-to-face interviews produced higher response-rates and were thus selected.

4.2.2.2. The life satisfaction questions

Following Veenhoven (2014) and several LS surveys [such as the Happy Planet Index (2014) by the New Economics Foundation and the Sustainable Society Index by the Sustainable Society Foundation (2014)], the survey asked respondents to rate their *'overall life satisfaction'* on a Likert scale. The LS question (English translation in Figure 4.5) was asked before the CV scenario. The statement was straightforward as it is in other LS studies (Fujiwara & Campbell, 2011) and featured a scale from 1 to 10.

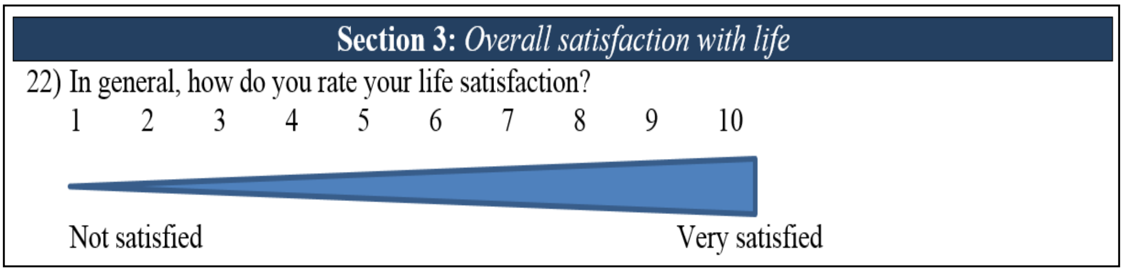


Figure 4.5: The life satisfaction question used during the pre-test survey (English translation).

Life satisfaction scores were mainly concentrated at 6 (30%), 7 (20%) and 8 (20%), suggesting the scale was too coarse. As such, to widen variability of possible answers for the LS question, the scale for the LS question was changed from *'1 to 10'* to *'0 to 100'* in the final questionnaire. The zero (*'0'*) option was added to allow respondents to indicate that they are not satisfied with their overall LS.

4.2.2.3. The pre-test CV scenario

Based on the results from the FGDs, flood problem was presented on the pre-test questionnaire.[16] Figure 4.6 (English translation) provided a brief description of these problems, with their corresponding solutions based on the literature and the FGDs. This information was presented before the WTP question (Figure 4.7), in order to introduce the respondents to the hypothetical scenario and improve their familiarity with flood risk/flood prevention. Specifically, the maximum amount respondents were willing to pay annually to minimise impacts from floods and other natural disasters, was sought from the respondents. I asked respondents, with a diverse range of

[16] Initially, I explored two environmental problems known to be problematic in the region: floods and solid waste. For a variety of reasons, I later decided to focus on one environmental problem: floods. First, there were more responses about flooding experiences than that of solid waste management in the FDGs. In addition, flood impacts were known to worsen in the future and were strongly put forward by respondents during the FGDs. Photographs have affect WTP responses (for example, see Figure 4.6). Admittedly, the photo used to show the flooding problem may have elicited a *'positive'* idea and therefore associated to a less significant problem. To correct this, I opted not to use photographs in the final survey.

incomes, their maximum WTP. Twelve pesos values (out of 14) were identified most frequently: ₱2 (20%), ₱3 (20%), ₱5 (52%), ₱10 (56%), ₱15 (28%), ₱20 (68%), ₱30 (28%), ₱50 (60%), ₱100 (64%), ₱200 (20%), ₱500 (44%), ₱1000 (32%). On the other hand, there were no protests for *'donation'* as a way to seek payments or the *'barangay hall'* as a way to gather these payments, during the FGD discussions.

PROBLEM: Flooding of rivers

Impacts
Damages houses and other properties
Damages crops and other agricultural products

Possible solutions include
Alternative livelihoods
Sustainable reforestation projects
Effective implementation of logging permits and other regulations

Figure 4.6: Environmental problems identified during the pre-test survey (English version).

24) Willingness to pay (payment card)

Imagine if the fund will be raised, your household will be asked to donate once to this fund through collection through barangays. What is the maximum amount (in ₱), you would be willing to pay for each of the problems mentioned.

Through these interventions, solid waste will be minimised, which will in turn create a clean and disease-free neighbourhood. The risk of flooding will also be minimised with these interventions.

	Money donated ______													
	₱ 0	₱ 2	₱ 3	₱ 5	₱ 10	₱ 15	₱ 20	₱ 30	₱ 50	₱ 100	₱ 200	₱ 500	₱ 1000	More than ₱ 1000
Flooding	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐How much? ₱ ______

Figure 4.7: The willingness to pay (WTP) question used during the pre-test survey (English version).

4.2.2.4. Other questions

To control for factors relating to LS and WTP, questions about socio-demographic characteristics and the regionally relevant factors from the FGDs were also asked. Furthermore, information about flood experiences was also included.

4.2.2.5. Translation to Hiligaynon

Back translation is important in cross-cultural research because it can translate *"consistent meanings and ideas of instruments across cultures"* (Li, 2012, p. 7). Brislin (1970) described this process as:

> *"Two bilingual are then employed, one translating from the source to the target language, the second blindly translating back from the target to the source. The investigator now has two versions in the original language, which, if they are identical, suggest that the target version from the middle of the process is equivalent to the language forms"* (p. 185).

This method has also been used in a few other cross-cultural economic valuation studies (Wagner, Hu, Dueñas, & Pasick, 2000; Mansor, De Run, & Latif, 2005). Therefore, in order to fully understand the *'value'* of minimising the impacts of flood and respondents' overall LS, the final questionnaire was carefully translated using this method. To be specific, two individuals were hired to translate: one from English to Hiligaynon and another from Hiligaynon to English. After which, I compared the two versions, made some necessary corrections and finalised the instrument for the final survey.

In summary, minor alterations to the pre-test survey questionnaire were adopted. Using the findings from the FGDs and pre-test survey, I commenced the final survey. This is discussed next.

4.3. Main survey

4.3.1. The final survey questionnaire

Based on the arguments in the review of related literature (Chapter 2), preliminary results from the FGDs (Section 4.2.1) and the pre-test survey (Section 4.2.2), I made several changes to the draft survey questionnaire, which culminated in the final survey questionnaire (Appendix H), which has the following sections:

1) Research background – this section introduced the research and described the objectives of the study. It also specified that the respondent had the right to refuse to participate and highlighted the confidentiality of the collected information. Instructions were also presented in this section.
2) Flood experiences – this section included questions about flood impacts, frequency of flood in their household and flood mitigation activities.

Respondents were asked to recall and list any flooding event(s) they had experienced since 2007, together with the corresponding level of the floodwater through their house and the monetary damages (costs to personal property, employment/livelihood losses and additional damages) incurred. Additionally, respondents were asked to rate [on a scale from 1 (not threatened] to 5 (very threatened)] the perceived threat, which each flood event posed to the safety of their family, friends and close relatives. I also asked about the flood mitigation activities of the household as well as the level of effectiveness (using a Likert scale) of flood programs or assistance from the government and other institutions.

3) Life satisfaction (LS) - this section asked for respondents' assessments of their overall LS. Specifically, they were asked to rate their *'overall life satisfaction'* (on a scale from 0 [not satisfied] to 100 [very satisfied]).
4) Willingness to pay (WTP) – this section presented the hypothetical scenario. Background information about flood and its impacts were first presented; and then respondents were asked how much they were willing to pay to prevent the damages they incurred from floods.
5) Perceptions/attitudes and debriefing questions – this section asked for the level of agreement (using five-point Likert scale) about conditions of floods and their neighbourhood (e.g. road condition), as well as their perceptions about themselves and their household (e.g. financial security, religion, etc.). Also included in this section were statements pertaining to the hypothetical scenario (e.g. justification for their choices, beliefs about the scenario, etc.)

6) Socio-demographic information – this final section asked for individual (e.g. age, years of schooling and religion) and household (e.g. household size and income) characteristics.

4.3.2. Training of enumerators

Enumerators or surveyors may affect the outcomes of the survey (Whittington, 2002), so I organised a survey training session to minimise survey-related biases. I hired eight enumerators (four females, four males) to assist with the personal interviews and they were required to participate in a training session. First, I prepared a set of guidelines using the training design of Whittington (2002) for the interviewers of CV surveys in less-developed countries. Activities in the familiarisation of the questionnaire and proper handling of the CV scenario were completed. I also conducted role-playing activities to introduce the enumerators to common problems and possible solutions when conducting surveys. Two researchers from the University of the Philippines Visayas, who had experience with contingent valuation surveys in the Philippines, were also invited. The training was conducted in Iloilo City and lasted for 10 hours.

4.3.3. Main survey sampling

I devised a multistage sampling strategy that allowed me to collect data from multiple individuals within a particular *'barangay.'* According to Kalton (1983), a multi-stage sampling involves a hierarchy of clusters, where large clusters were selected first, followed by a selection of sub-set clusters. Geographically stratified random sampling was used to select *barangays*, while purposive sampling was sought for recruitment of households in each *barangay*. By using this sampling strategy, the sample was both geographically (i.e. areas close/far from rivers, coast, etc.) and demographically (i.e. diverse socio-demographic characteristics) stratified.

In my case, surveys of residents in the Philippines involved three levels of selection: first, sample towns/city (selection of MI region was discussed in Chapter 3), second, samples of *barangays* and finally, samples of households within the selected *barangays*. I selected 33 *barangays*, for inclusion in the study on the basis of their location and their socio-economic structure. Selection specifically aimed to ensure that the sample included communities, which were close to and further away from, rivers and floodplains and incorporated a variety of different industries, with varying average incomes.

First, using a map, the study region was equally divided into 33 grids, which covered the six (partially) urban/rural areas (Cabatuan, Leganes, Oton, Pavia, San Miguel and Sta. Barbara) and one highly-urbanised area (Iloilo City). For each of the six partially urban/rural areas, I selected one *barangay* per grid.

After selecting the *barangays* and corresponding sample size for each, I purposively selected the households to be interviewed. I interviewed 16 residents aged 18 or older (from different households), in each community. In Iloilo City, I recruited 34 residents within each grid. Since there were four grids in this area, my sample contained 136 (34x4) city residents and 464 (16x29) less urbanised residents. Hence in total, personal interviews were conducted with 600 Filipinos (Figure 4.8). According to Ornstein (2013), voluntary recruitment is ideal; stating that: *"If the intended program is voluntary, however, the actual participants are likely to resemble the experimental participants, so there would be no bias"* (p. 5). I followed this argument and targeted adults (i.e. 18 years old or above), preferably the household head or spouse, who were willing to be interviewed. In cases where the head and spouse were not available, interviews were conducted with any family member who was employed. Most questions in the questionnaire were related to household and individual decisions, so this criterion suffices.

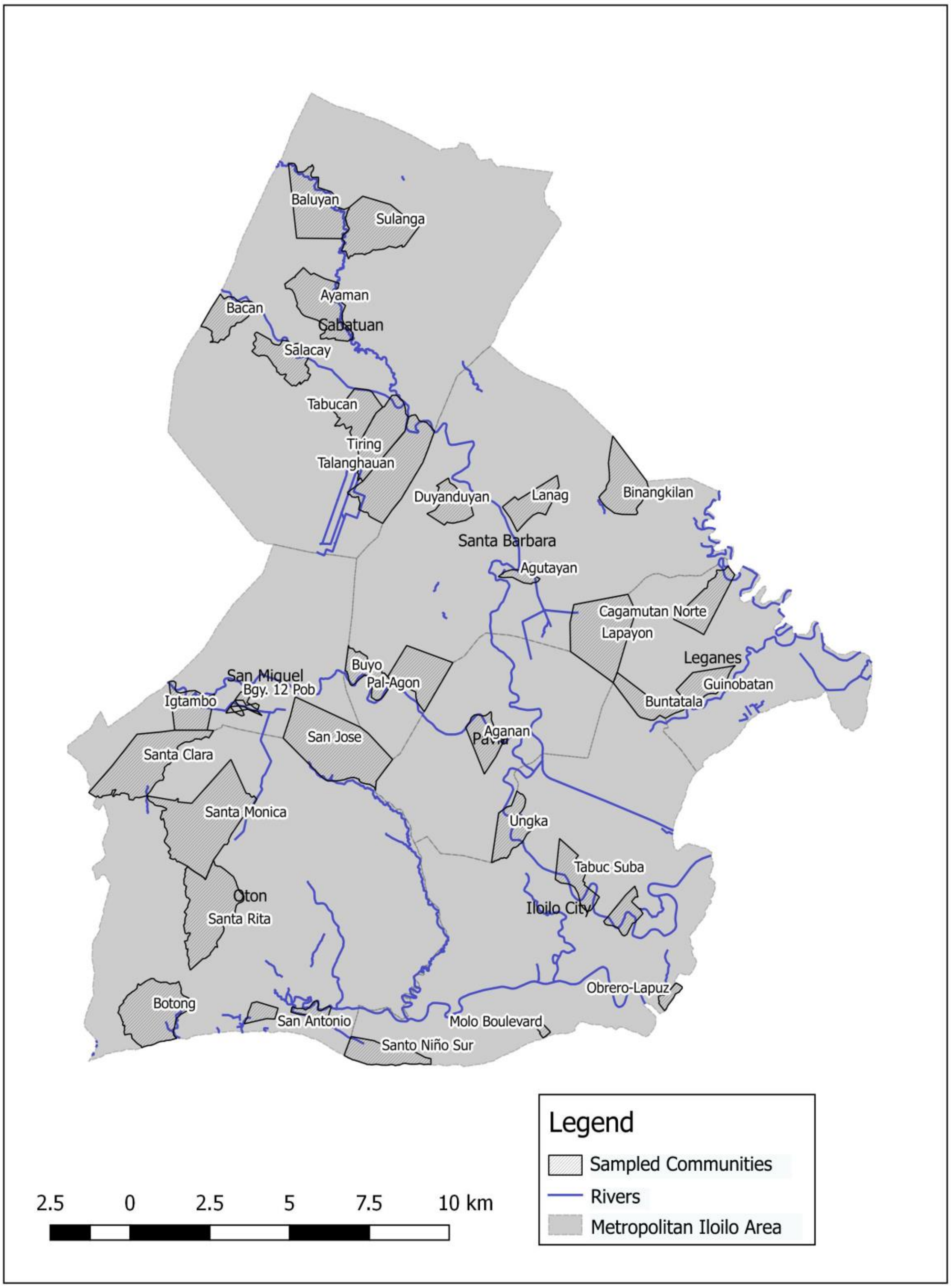


Figure 4.8: Sampled barangays (communities) in the Metropolitan Iloilo (map by Ubo Paes).

Table 4.5: Sampled barangays (communities) per town/city, n=600.

Towns/Barangays	Towns/Barangays	Towns/Barangays
Oton (=96)	**Cabatuan (=128)**	**Sta. Barbara (=96)**
1. San Antonio	12. Bacan	24. Lanag
2. Sta. Rita	13. Tabucan	25. Palag-on
3. Poblacion West	14. Salacay	26. Binangkilan
4. Sta. Clara	15. Sulanga	27. Agutayan
5. Sta. Monica	16. Baluyan	28. Duyan-duyan
6. Botong	17. Ayaman	29. Buyo
San Miguel (=48)	18. Talanghaun	**Iloilo City (=136)**
7. Igtambo	19. Tiring	30. Ungka I
8. San Jose	**Leganes (=64)**	31. Bo. Obrero
9. Barangay 12	20. Buntatala	32. Sto. Niño Sur
Pavia (=32)	21. Guinobatan-Norte	33. Molo Boulevard
10. Aganan	22. Cagamutan-Norte	
11. Tabuc Suba	23. Lapayon	

Purposive sampling was used to recruit participants. Ornstein (2013), however, noted that this type of sampling might create a bias in terms of socio-demographic representation, mostly sampling individuals who were more educated or articulate. I recruited respondents at their houses in the selected communities. Also, the participants were selected in consultation with *barangay* leaders; my aim being to ensure that there were representatives from a cross-section of different industry sectors. The selection of participants in various socio-demographic statuses (e.g. poor and rich) was also given attention. Additionally, the sample distribution allowed us to identify key problems in the MI area and households' actual flood impacts and identify a realistic scenario with respect to flood impacts, mitigation measures and a payment vehicle for the CV scenario. The interviews lasted for 15 to 25 minutes and were conducted from July to August 2013.

4.4. Description of sample population

This section presents descriptive statistics of the data used in this thesis. I focus on the households that lived in the current community for the last five years. Other statistics relating to the hypothesised associations presented in Chapter 2 will be discussed in Chapters 5, 6 and 7.

4.4.1. Socio-demographic characteristics of respondents

The mean age of respondents was 47 years old and the largest proportions were aged 45-54 (23%) (Figure 4.9). Of those recruited, more females (71%) were interviewed than males (29%). According to the Philippine Statistics Authority (2015), there were fewer females (49.2%) than males (50.8%) in the Iloilo Province; thus, females were oversampled in my survey. This can be explained by the fact that interviews were conducted on weekdays from eight in the morning to four in the afternoon, when most men were working. Since my sample is not representative, I therefore ensured that all regressions included a dummy variable to control for potential bias introduced by this imbalance (although, it was never statistically significant – see Chapters 6 and 7 for more details).

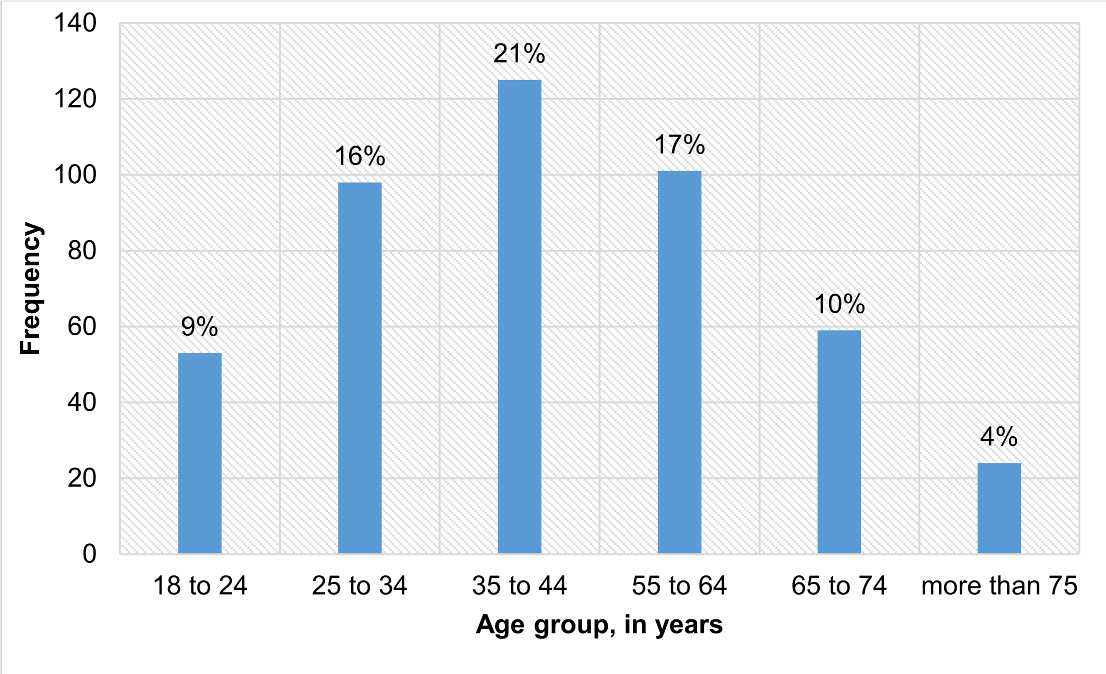


Figure 4.9: Age groups of survey respondents.

As shown in Figure 4.10, 53% of those interviewed attended school for 10 to 13 years. Only 7% of the respondents had been to school for less than 6 years. This implies that most respondents have finished elementary education (usually 6 years), which is likely a result of free access to elementary and high school in public schools (simple literacy rate = 93.8) (PSA, 2015).

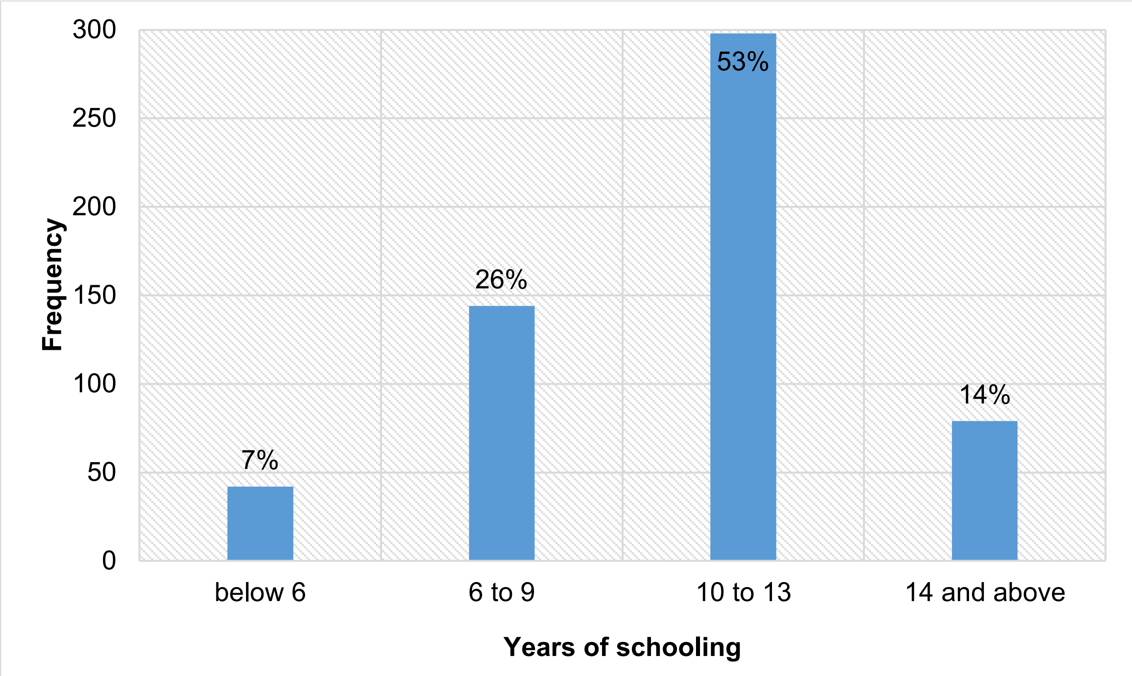


Figure 4.10: Years of schooling of survey respondents.

In the survey, I asked for respondents' employment status (employed, unemployed or retired / domestic worker) and degree of agreement (Likert scale 1 *'strongly disagree'* … 5 *'strongly agree'*) to the statement, *'I am gainfully and securely employed*.' I combined the answers to these questions in order to measure job security, using the following criteria:

- If the respondent indicated that he/she is *'employed'* and rated level of agreement of either 1, 2, or 3, then I classified him/her as *'insecurely employed.'*
- If the respondent indicated that he/she is *'employed'* and rated level of agreement of either 4 or 5, then, *'securely employed.'*
- If the respondent indicated that he/she is *'unemployed'*, then, *'unemployed.'*
- If the respondent indicated that he/she is *'retired / domestic worker',* then, *'not in labour force.'*

Nearly half of those interviewed (47%) were not participating in the labour market (Figure 4.11). This group of respondents refers to those who work at home without a wage (e.g. housewives), or are retired. This outcome is not surprising as most of the respondents were females who stayed at home and were available for interview. One in five indicated that they were securely employed. While 18% and 13% were unemployed and insecurely employed, respectively. I used these indicators for job security in the analysis of LS in Chapter 6.

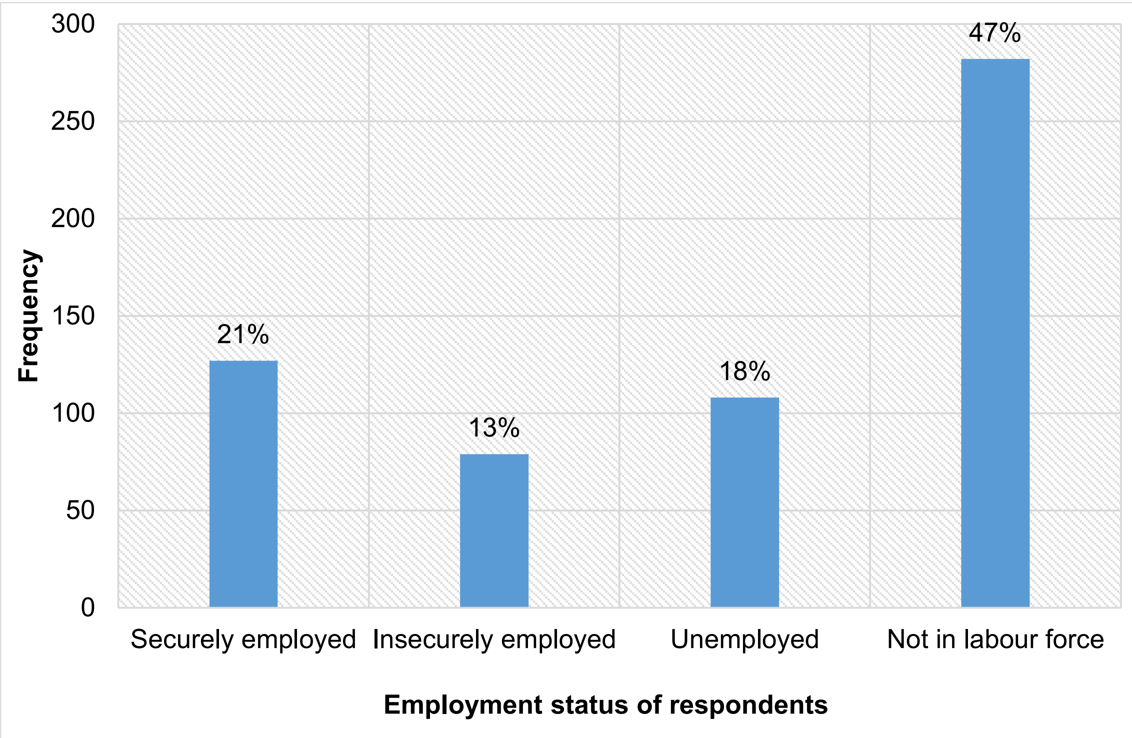


Figure 4.11: Employment status of respondents.

4.4.2. Household income and percentage of food grown at home

Previously (Chapter 2), I described that income is an important determinant of both overall LS and WTP for flood prevention. Knowing this, I asked the respondents to identify sources of their household income (e.g. employment, pension, remittance and interest) and to indicate their total monthly income for each source (by ticking a box next to different income categories).[17] I converted income responses into a continuous variable – i.e. the approximated value of a particular source of income was equivalent to the midpoint average for the corresponding income range. Some respondents identified multiple sources of income, so I aggregated the values to generate the total annual household income.

Figure 4.12 presents average household income of residents per year at various sampled communities. It is apparent in the figure that the mean income across this sample was ₱79,721. Botong in the town of Oton had the highest income of all sampled communities at around ₱150,379 per household per year. Collectively, the annual household incomes of *barangays* are above the provincial poverty income threshold of ₱16,584. Nevertheless, the minimum household income reported was ₱12,000 per year, which is below this threshold; indicating that I have included poor households in my sample. The highest annual income was ₱1,872,000 (US$41,592). [18]

[17] When asked about the different sources of income of the households, respondents said that majority of their incomes came from members' salary/incomes. Remittances from members of the households were also identified but covered only a small proportion. In this thesis, I am not particularly interested in remittances and how they may affect flood risks – rather, I looked at how multiple occupations, number of household members, children, and other household/individual characteristic may affect flood damages, willingness to pay, and their life satisfaction.
[18] ₱45 = US$1 (2015 currency conversion)

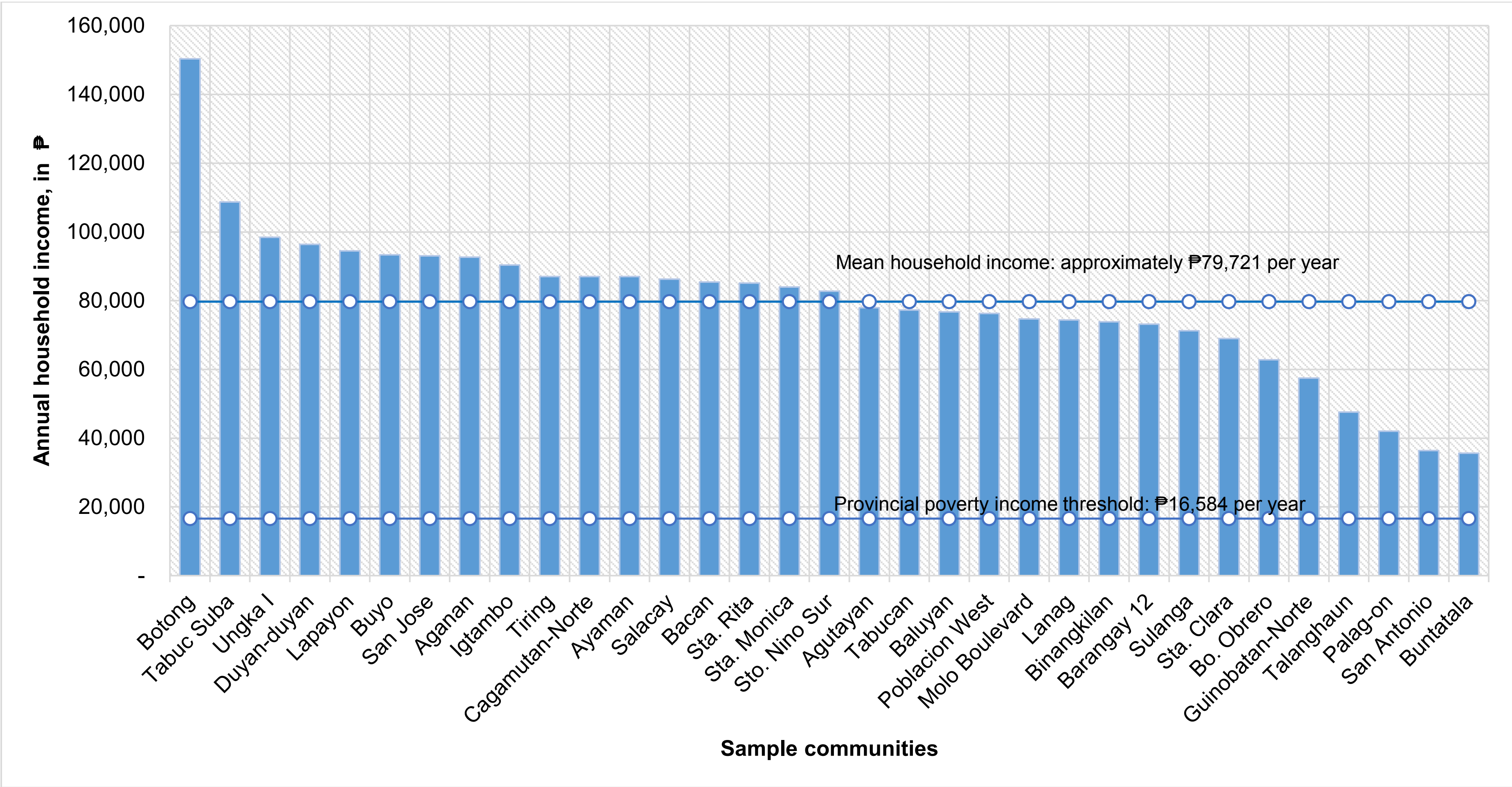


Figure 4.12: Reported annual household income per barangay (community).

Food production at home affects households' disposable income (Gorodnichenko, Peter, & Stolyarov, 2010). Also, consumption patterns in the Philippines are different in agricultural and/or rural households (Fujii, 2013). Therefore the percentage of food grown at home was also recorded from the interviews (Figure 4.13). Out of those who responded to this question, 144 respondents (24%) belonged to a household that does not grow any food; while 130 and 120 households grew 20% and 30% of their total annual food consumption, respectively. But there was also a considerable proportion (25%) of households that grew 50% or more of their food consumption. This information was then used to revise estimates of household income and will be discussed further in Chapter 7.

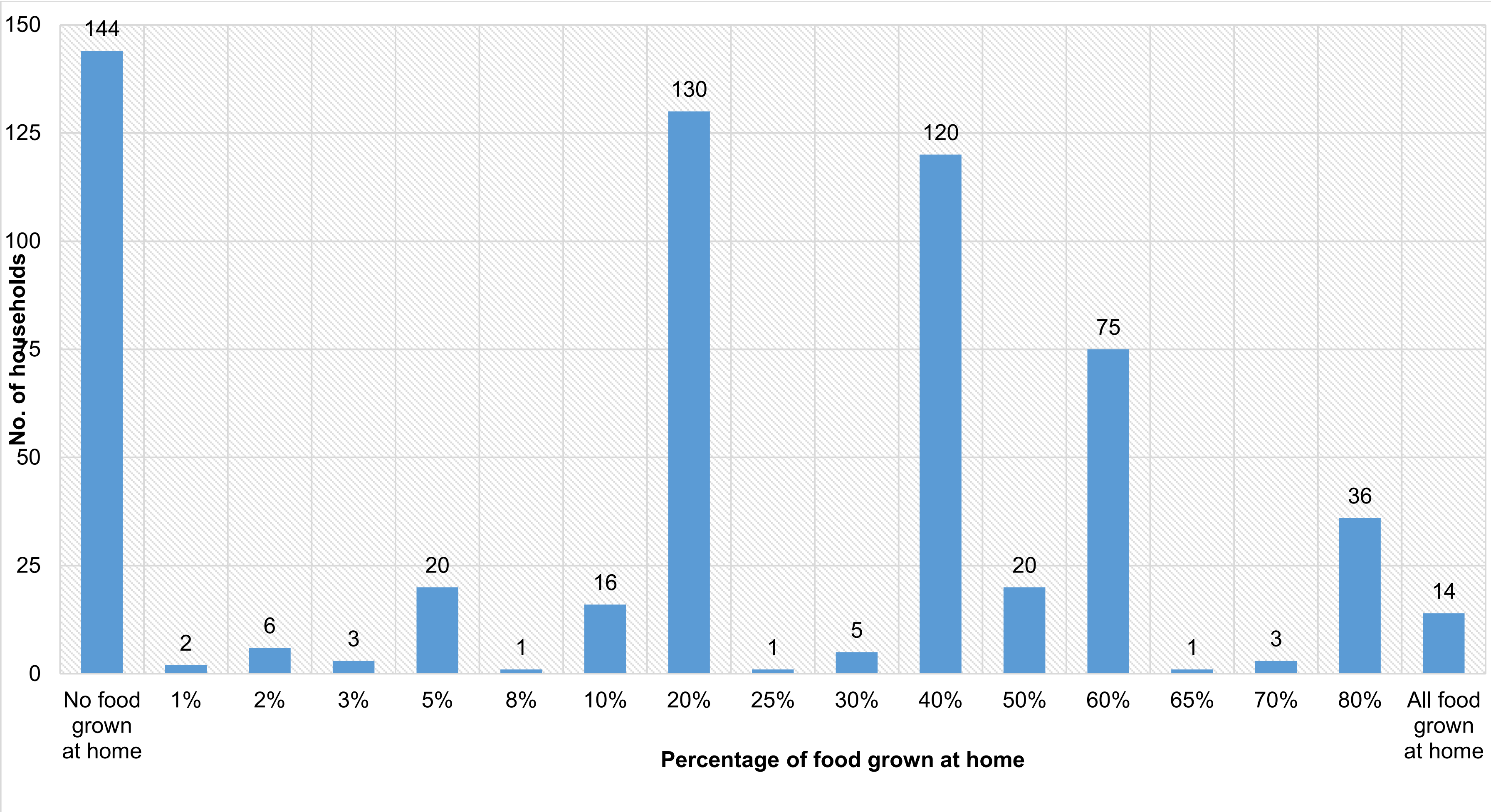


Figure 4.13: Proportion of food grown at home.

4.4.3. Socio-demographic characteristics of respondents and their households

As mentioned in Chapter 2, household characteristics such as having children may also influence reported LS. Similarly, household WTP may be dependent on various household characteristics such as household income. The last section of the questionnaire also asked for household information, which was used in the analysis for flood damages, WTP and LS. Figure 4.14 reports the household profiles of respondents. Clearly, the majority of respondents belong to households with 2 adults (37%) or 3 adults (20%); 26% contained one child and another 26% contained two children. That is, households interviewed usually have 3 adults and 2 children at home (average household size was equal to 4.9). According to the PSA (2015), this figure is similar to the average provincial household size of 4.8.

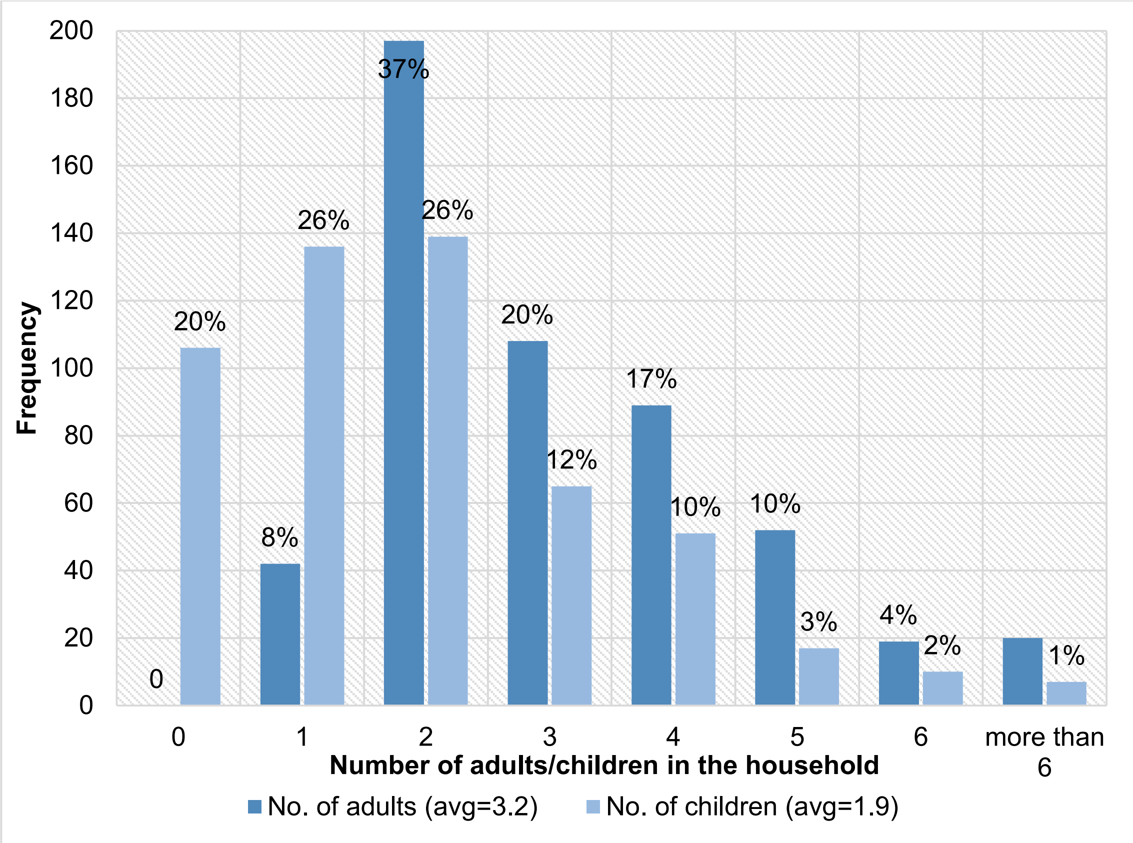


Figure 4.14: Number of adults and children in households.

Multiple occupations help households to mitigate flood damages by providing the ability to distribute the risk to different occupations (Reardon & Vosti, 1995); so the questionnaire included questions about occupational multiciplity. A clear majority of the respondents (71%) belonged to households with one source of income, while 25% reported two occupations and others listed three (3%), or more than three (1%) occupations (Figure 4.15). Most were dependent on salaries/incomes. This information was used in the WTP analysis in Chapter 6. [19]

[19] Aside from the number of income sources in the households, respondents were asked if their sources of incomes were dependent on rivers, forests and/or other natural resources. Around 65% of households were reliant on natural resources, while the rest indicated otherwise. This information is used when I was looking for an instrumental variable (IV) for monetary flood damages (discussed in Chapter 7). But it was found to be an inappropriate IV, so it was not used in the final WTP model.

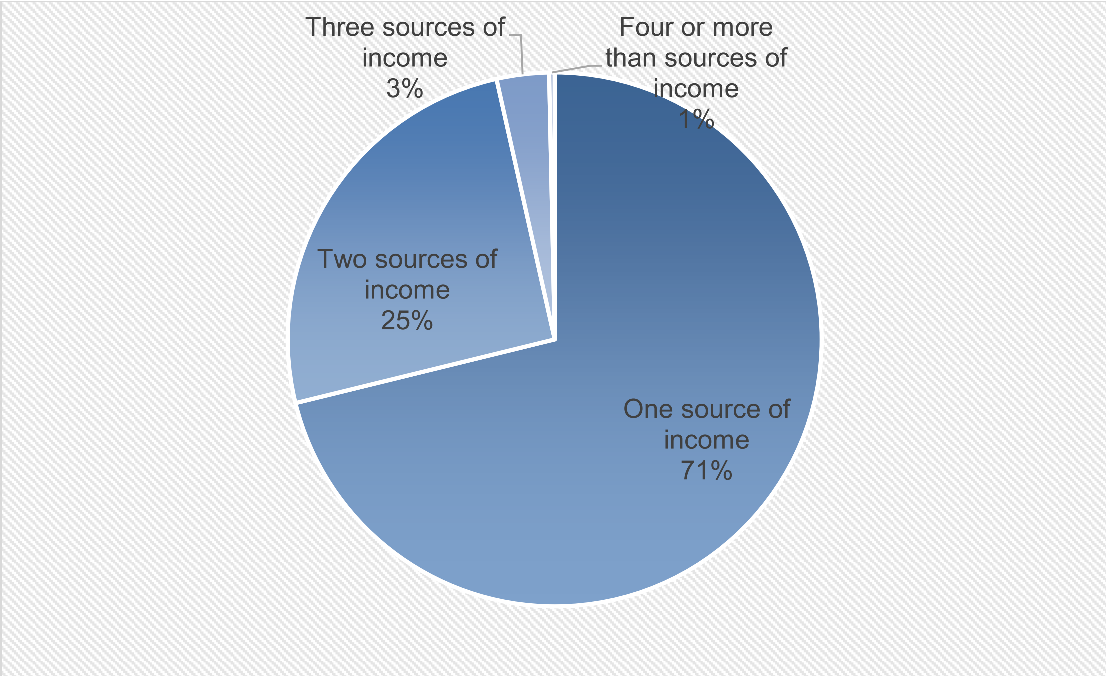


Figure 4.15: Household occupational multiplicity.

4.4.4. Knowledge about flood and their environment

In the interviews, I asked people's level of agreement (using a scale of 1-mostly disagree, 5-mostly agree) with statements relating to their understanding of the roles of rivers and forests to floods (Figure 4.16). There was a clear trend of agreement that rivers and forests were important and were associated with flood conditions. This was true for all five statements. Initially, this information was included on the questionnaire because the literature suggests that the level of knowledge about the environment affects WTP (Calderon et al., 2013). Unfortunately, as shown in the figure, responses were highly skewed with almost all respondents providing identical answers. Therefore, I expect them to be insignificant once included in the statistical analysis, so I chose to omit them in the final analyses.

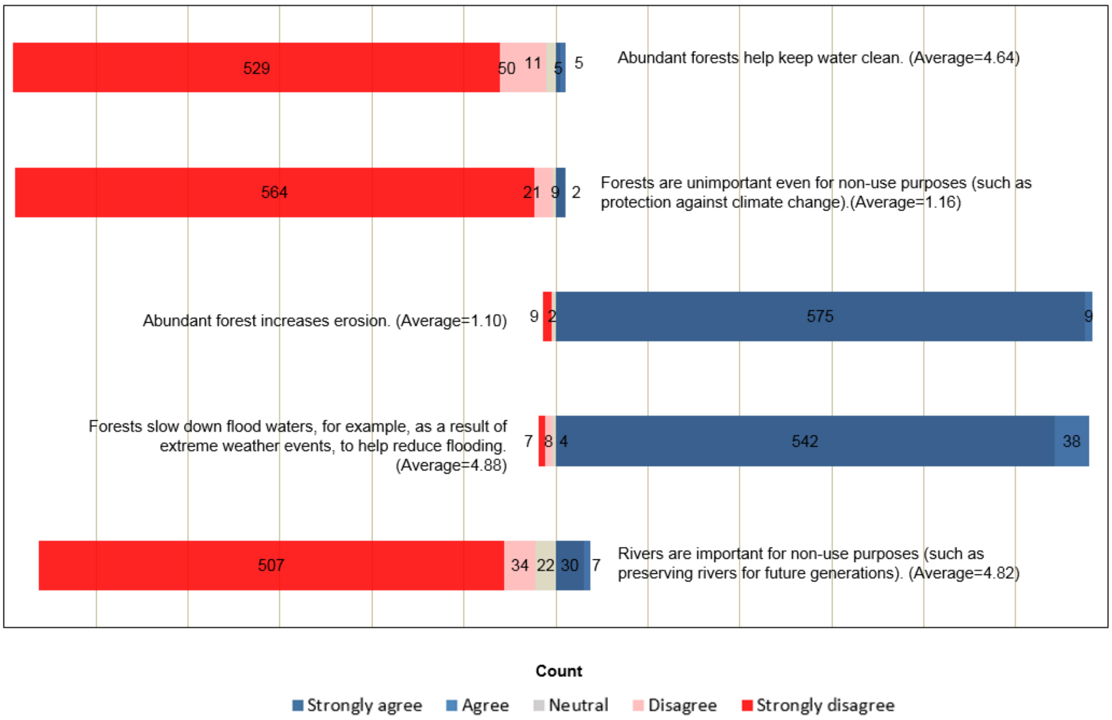


Figure 4.16: Knowledge about rivers, forests and floods.

4.4.5. Perceptions about some indicators of overall life satisfaction

Chapters 1 and 2 presented general discussions of LS and its determinants. I focused on some of these factors that matched those from FGDs. A total of seven statements relating to determinants of LS were included in the final survey. Specifically, respondents were asked to rate their level of agreement to these statements (using a scale of 1-mostly disagree, to 5-mostly agree) (Figure 4.17). I randomly alternated between statements that were framed positively and negatively to avoid acquiescence (or the tendency of respondents to agree/disagree without fully understanding the statements) (Podsakoff et al., 2012).

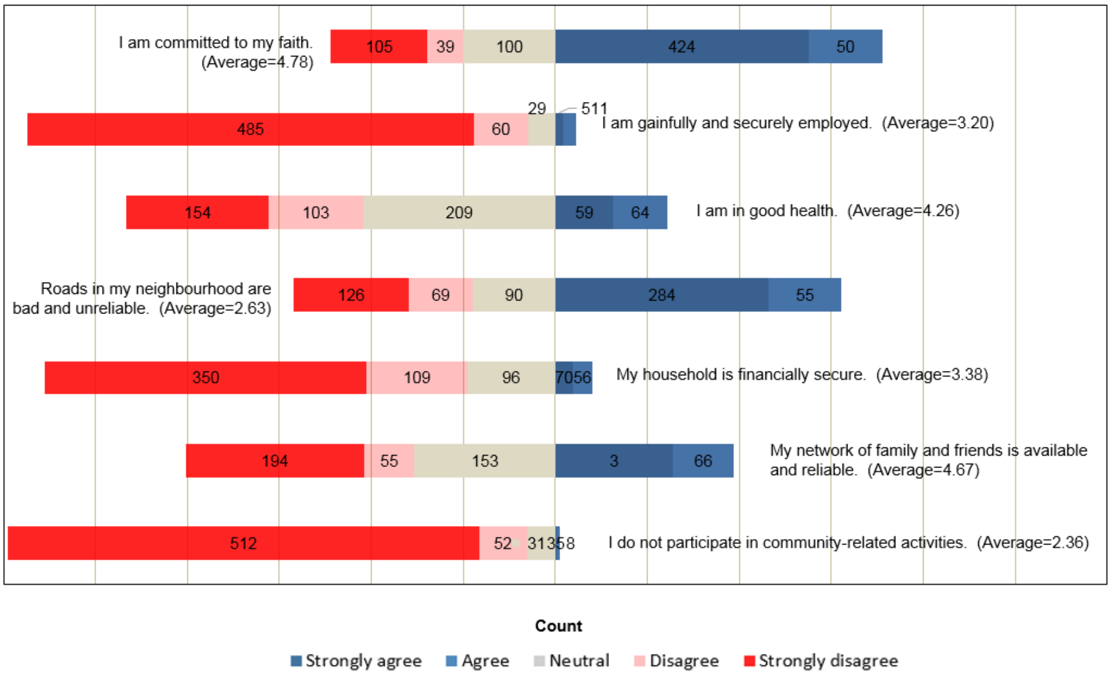


Figure 4.17: Perceptions about self, family and neighbourhood.

There were three statements relating to one's self. 474 Respondents perceived that they were religious, specifically indicating '*agree'* (424) and *'strongly agree'* (50) to the statement, *'I am committed to my faith.'* In contrast, there were more negative responses to the statement, *'I am gainfully and securely employed.'* (485 for *'strongly disagree'*). 209 Respondents were neutral when asked, *'I am in good health.'*

'Roads in my neighbourhood are bad and unreliable.' relates to one's perception about their neighbourhood. In response to this statement, a range of responses was elicited: 284 (*'agree'*), 55 (*'strongly agree'*), 126 (*'strongly disagree'*), 69 (*'strongly disagree'*) and 90 (*'neutral'*).

Perceptions about their household and neighbours were also asked using the same scale. For the statement, *'My household is financially secure.'* around 350 *'strongly disagree',* while only 56 *'strongly* agree'. One hundred ninety four and 55 respondents rated *'strongly agree'* and *'agree'* respectively, to the statement: *'My* *network of family and friends is available and reliable.'* 153 Respondents indicated *'neutral.'* The respondents have similar responses when asked, *'I do not participate in community-related activities.'* (512 - *'strongly disagree'* and 52 - *'disagree'*).

4.4.6. Flood damages

As discussed in Section 2.3, the CV scenario should be understandable to the respondents and the information about floods should also be realistic. Assessment of damage is situated at the beginning of the survey, before the CV hypothetical scenario. This is crucial for getting the CV scenario right, so I asked the respondents' flood experience to prompt their recollection of floods. Since I have information of respondents' monetary damages they incurred, I drew on real flood experiences for the scenario to increase their familiarity. This is to avoid novelty bias. Vatn and Bromley (1994) and Fuks and Chatterjee (2008) highlighted that novelty arises because there is *'no learning process for evaluating benefits and the choice options.'* This means that respondents may have problems, because it might be their first time to be offered the good presented in the scenario or they are unfamiliar with its benefits. I discuss how I collected data on and subsequently estimate flood damages in Chapter 5.

4.4.7. Long-term residents

It is apparent that some respondents had resided in the community longer than their neighbours and, therefore, may have varying familiarity with flood impacts in their communities (Figure 4.18). Out of the 600 residents, I focus on a subsample of residents who had been in the community for the last five years (n=524) - the period of time that matches the question about flood damages.

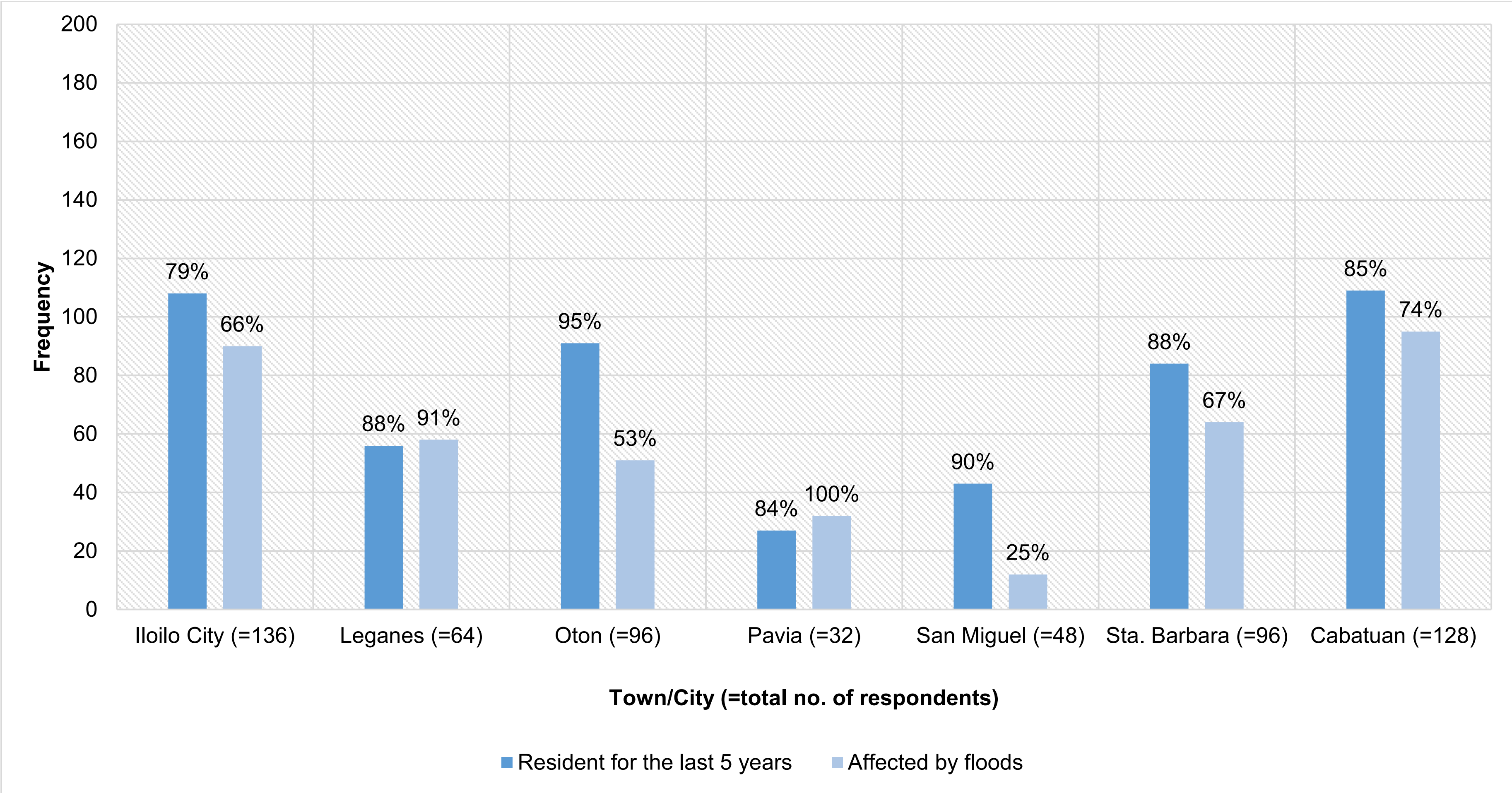


Figure 4.18: Long-term residents.

4.4.8. Life satisfaction scores

As discussed in Chapter 2, the LS approach explicitly asked individuals to state their overall LS through ratings. Figure 4.19 shows the distribution of these scores, which suggests an almost normal distribution. There were 21 respondents (3.5%) who rated their overall LS as *'very satisfied'* (91 to 100), while the most commonly selected score range was 71 to 80 (≈25%). Around 23% of respondents rated their satisfaction at 41 to 50, while approximately 15% and 14% of respondents's LS scores from *'51 to 60'* and *'61 to 70'*, respectively. A few respondents indicated that they were *'very satisfied'* with their overall life and indicated *'100.'* Moreover, it is also interesting to note that a few individuals indicated non-rounded numbers (e.g. 1 for 25, 35, 89 and 93; 2 for 45 and 65). This may be the case as it is natural for individuals to give rounded numbers as answers (Hausman, et al., 1993). I ran a Spearman-Rho correlation between life satisfaction scores and various categories flood damages (e.g. monetary flood damage and number of flood events). The findings reveal statistically significant negative correlation (as expected from the literature, Section 2.4) though very weak (below 0.2). I explore this further in Chapter 7.

Figure 4.19: Self-reported life satisfaction scores of respondents.

The average LS scores of various locations is presented in Figure 4.20. Residents of San Miguel (≈75) and Oton (≈70) reported the highest LS scores (Figure 4.20). On the other hand, scores in Iloilo City, Leganes, Pavia and Cabatuan were relatively low compared to the rest of the sampled locations. Most of these areas were more industrialised with high numbers of urban poor.

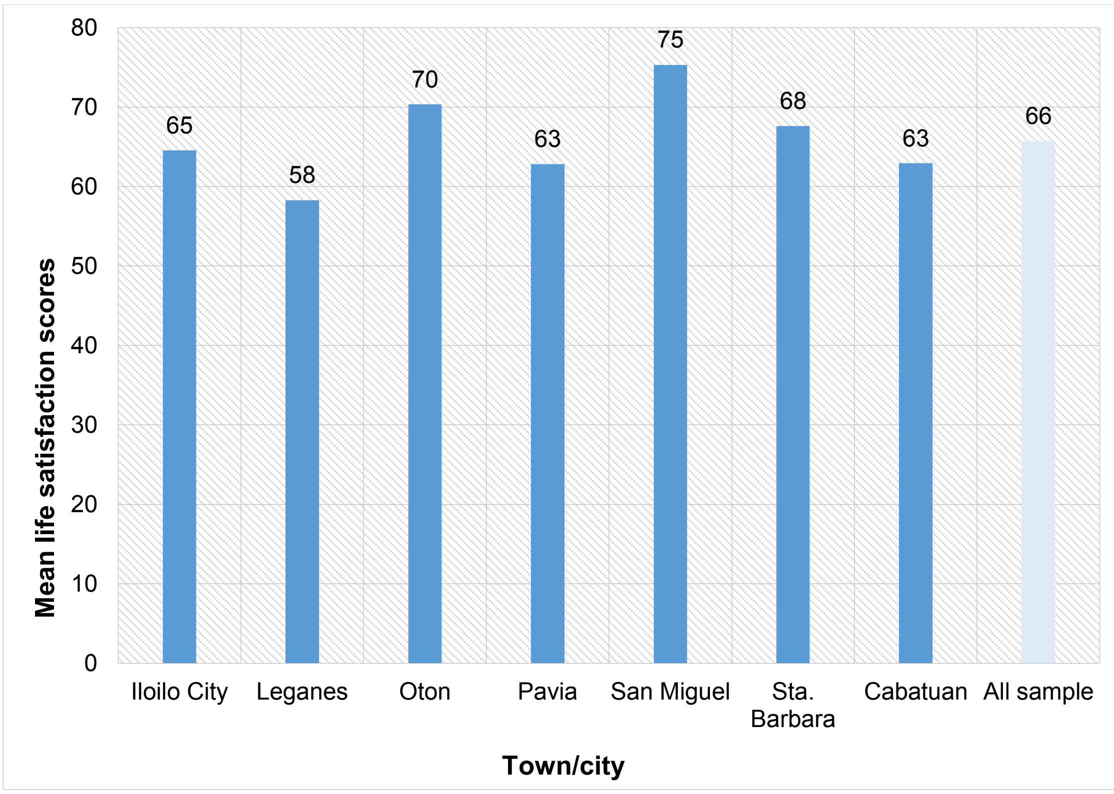


Figure 4.20: Mean life satisfaction scores per town/city.

Furthermore, Figure 4.21 presents the average scores for different categories of socio-demographic characteristics (gender, employment status, education years, age, and income decile categories). Both female and male respondents had similar scores while diversity of scores was evident between categories of employment, education and age. As expected, those who were securely employed had a higher mean score (67.09) than those who were insecurely employed (64.94). In addition, most educated respondents (years of education at least 14 years) rated high satisfaction scores, averaging at around 72 for this subset. Young respondents (age categories *'18 to 24'* and *'25 to 34'*) had low LS scores around 63 to 64. Clearly, score ratings vary per socio-demographic characteristic, but the relationships may be complex. In Chapter 6, I will further analyse the relationships using statistical analysis.

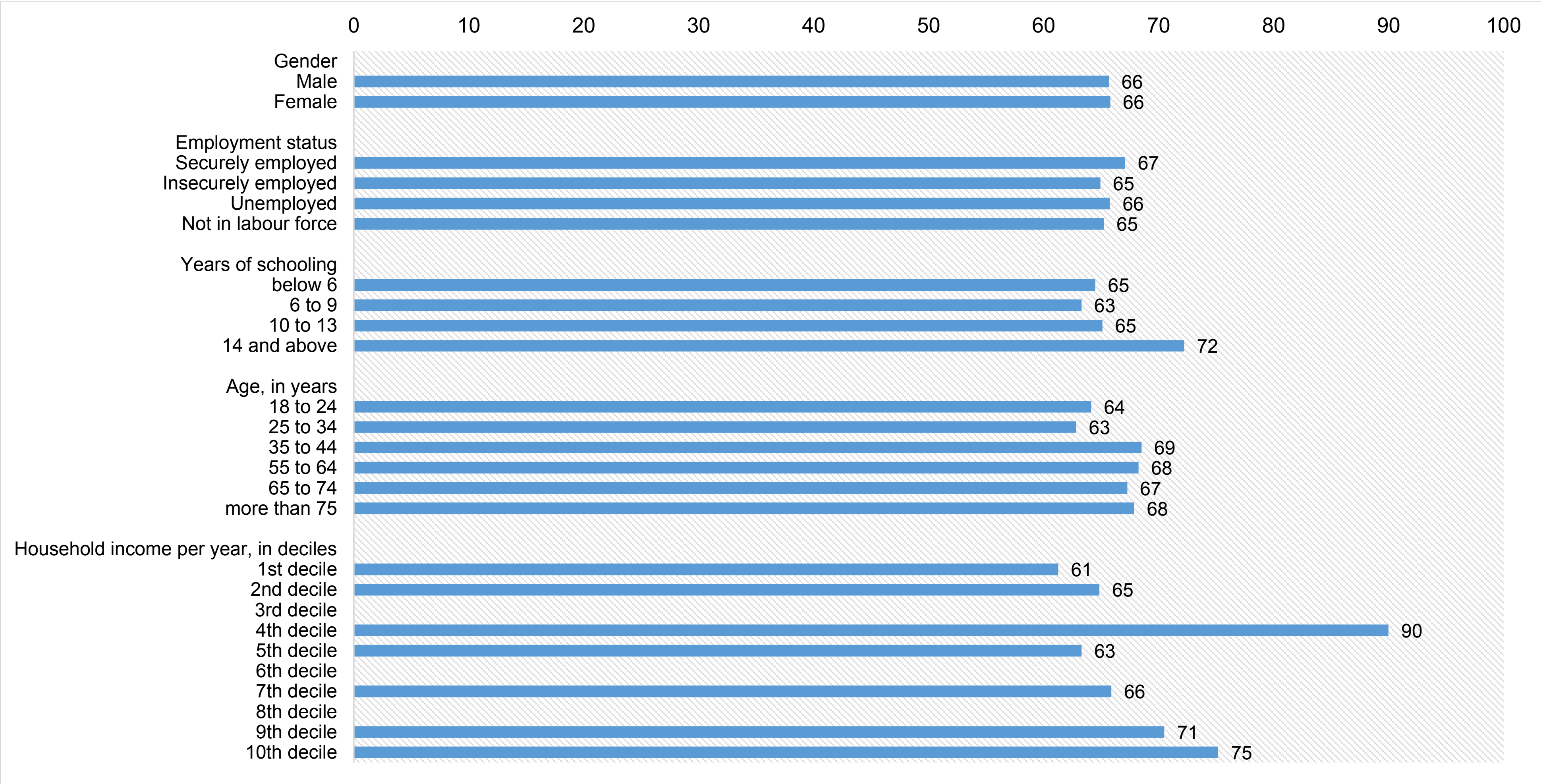


Figure 4.21: Mean life satisfaction scores to various socio-demographic characteristics.

4.4.9. Willingness to pay (WTP) for flood prevention

Respondents responded to the question about the maximum amount their households were willing to pay (WTP) to prevent future flood damages (Figure 4.22). The WTP question consists of amounts (prices), payment method (donation), payment vehicle (fund collected by the *barangay* council), and payment frequency (yearly and perpetual).

Suppose it was possible to prevent all future flood damage by, for example, building levees banks, etc. The only problem of course, is that it would cost money to do that. Suppose that a fund is set up to raise money for those levee banks and your household was asked to <u>donate</u> to this fund through a collection administered by barangays/communities What is the maximum amount (in ₱), you would be willing to donate each and every year to a fund that builds and maintains those levee banks, thus preventing you from ever experiencing flood damage again? _____________ (money donated)

₱ 0 ☐	₱ 2 ☐	₱ 3 ☐	₱ 5 ☐	₱ 10 ☐	₱ 15 ☐	₱ 20 ☐	₱ 30 ☐	₱ 50 ☐	₱ 100 ☐	₱ 200 ☐	₱ 500 ☐	₱ 1000 ☐	More than ₱ 1000 ☐ Please specify: ____

Figure 4.22: The willingness to pay (WTP) for flood prevention scenario.

Figure 4.23 summarises their responses based on their location. Annually, respondents were willing to pay around ₱125. On average, however, residents in the city of Iloilo and in towns of Leganes and Oton were willing to pay less. In addition, there were 34 (6%) respondents who indicated that they were not willing to pay. The maximum amount was ₱1,000 and was stated by 18 (3%) respondents.

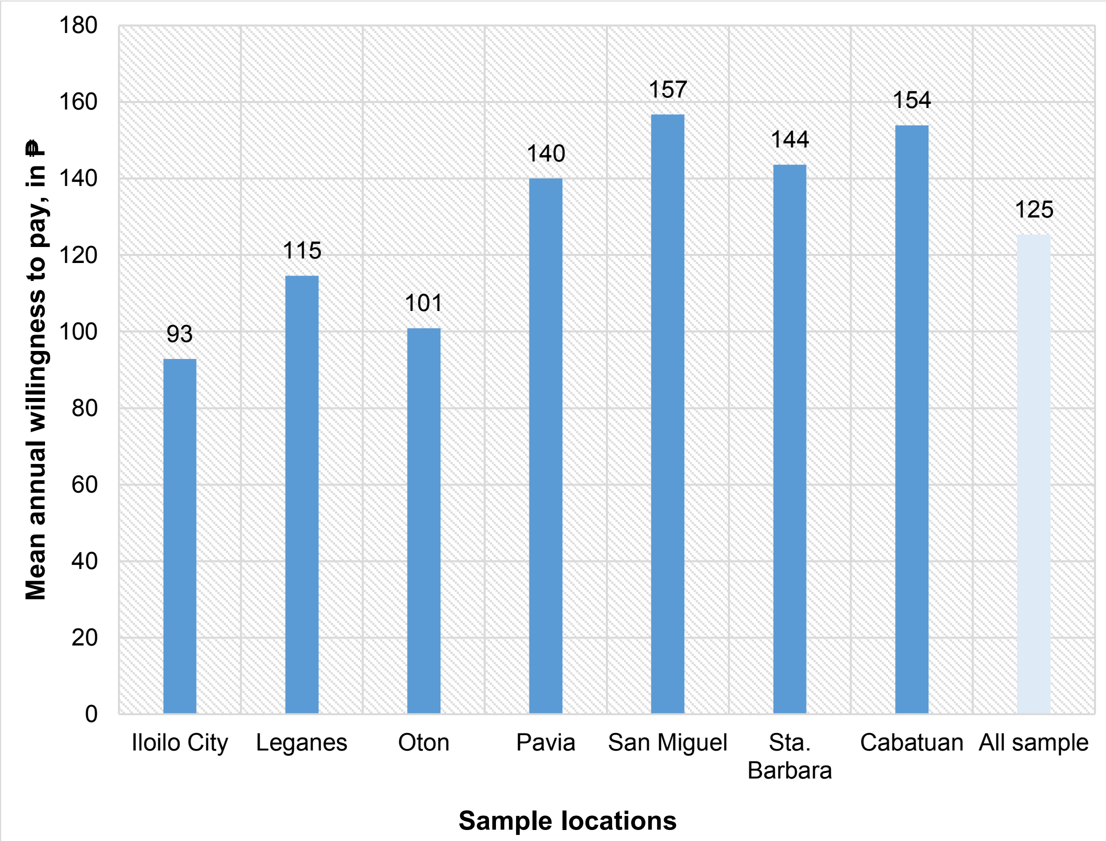


Figure 4.23: Mean annual willingness to pay (WTP) scores per town/city, in ₱.

As discussed in Chapter 2, WTP responses may be influenced by socio-demographic characteristics. In Figure 4.24, I present gender, employment, education, age and income decile categories and the corresponding WTP for each of these categories. It is apparent that the amounts vary for all the selected socio-demographic characteristics. Females (₱115) were willing to pay less than males (₱150), while those with secured employment (₱158) responded with larger WTP than those who were insecurely employed - ₱80; unemployed - ₱128; and not in the labour force - ₱120). It was also obvious that as the number of years of education increased, so did WTP. Respondents with highest number of years of education were willing to pay, on average, ₱192 a year to prevent flood damages. Those who did not attend any school or who attended up to five years were only willing to pay ₱66 a year. Also, young respondents were willing to pay more than the older ones. A more in depth analysis on WTP is presented in Chapter 7.

Spearman-Rho correlations were also executed to explore the relationship between WTP and various categories flood damages (e.g. monetary flood damages and number of flood events). Results show that there was a weak statistically significant negative correlation between mean number of floods and WTP. However based on the studies from Section 2.3, the relationship is not straightforward, so I analyse this further in Chapter 6.

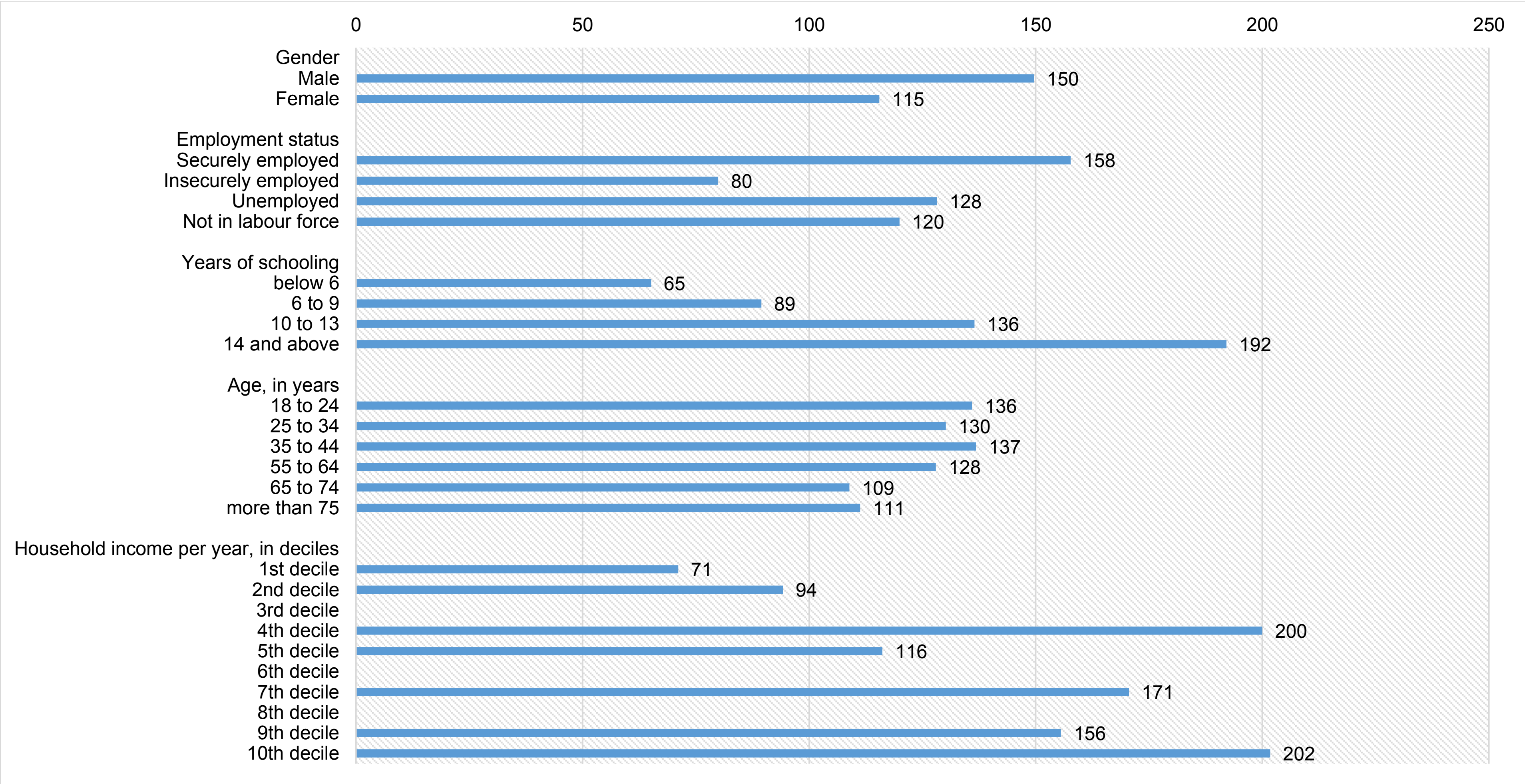


Figure 4.24: Annual mean willingness to pay (WTP) – according to various socio-demographic characteristics, in ₱.

4.4.10. Perceptions and attitudes towards floods and CV scenario

The validity of the WTP responses may depend on respondents' perceptions about the payment vehicle and their level of flood risks (Fuks & Chatterjee, 2008). Follow-up questions, were used after the WTP question in the questionnaire. Here, I asked people's perceptions, attitudes towards flood and their environment/community and other statements that may explain their WTP choices (Table 4.6). I asked them to indicate (on a five-point Likert scale) the extent to which they agreed or disagreed with a series of statements.

Table 4.6: Follow-up questions for willingness to pay (WTP).

Statement	**Strongly agree %**	**Agree %**	**Neutral %**	**Disagree %**	**Strongly disagree %**	**Average mean score response**
I want to prevent the risk of flooding in my community.	6	1	7	3	83	4.56
I want future generations to enjoy a flood-free community.	1	0	0	1	98	4.96
There are other more important problems that need funding (other than preventing/avoiding flooding in my neighbourhood).	12	9	9	13	57	3.94
I do not believe that the fund would produce the promised levee banks (the money might just be wasted.	48	9	24	3	15	2.27
I do not believe that the levee banks would prevent future flood damages.	61	11	11	5	12	1.95
I do not care about the problems of flooding.	87	4	6	1	2	1.25
I do not believe that my household is at risk of being flooded.	72	9	6	3	10	1.69
I am not prepared to pay anything to minimise flooding unless others pay too.	42	11	31	2	14	2.35

The replies to, *'I want to prevent the risk of flooding in my community'* and *'I want future generations to enjoy a flood-free community';* accounted for 86% and 99%, respectively, of the disagreement responses. Around 13% and 57% of the participants responded negatively to the statement, *'There are other more important problems that need funding (other than preventing/avoiding flooding in my neighbourhood).'*

Most respondents were also sceptical, reflected in their strong agreement with the questions: *'I do not believe that the fund would produce the promised levee banks (the money might just be wasted).'* (48%); '*I do not believe that the levee banks would prevent future flood damages.'* (61%); *I do not care about the problems of flooding.'* (87%); and *'I do not believe that my household is at risk of being flooded.'* (72%).

Based on these results, it seems that respondents were either not worried about or underestimated their future risk from floods; this was despite the fact that there are substantial impacts of flood, as shown by the actual flood damages incurred. This observation has been investigated before, indicating that individuals are not good at judging their risks (Botzen & van den Bergh, 2012), especially risks associated with low impact but repetitive events, such as floods. It could also be possible that respondents did not want to participate in the hypothetical scenario. I will discuss these arguments, in particular the concept of *'scepticism'*, in the WTP for flood prevention chapter (Chapter 7) in more detail.

4.5. Chapter summary

This chapter presented the general methodology of this thesis and key points are provided below:

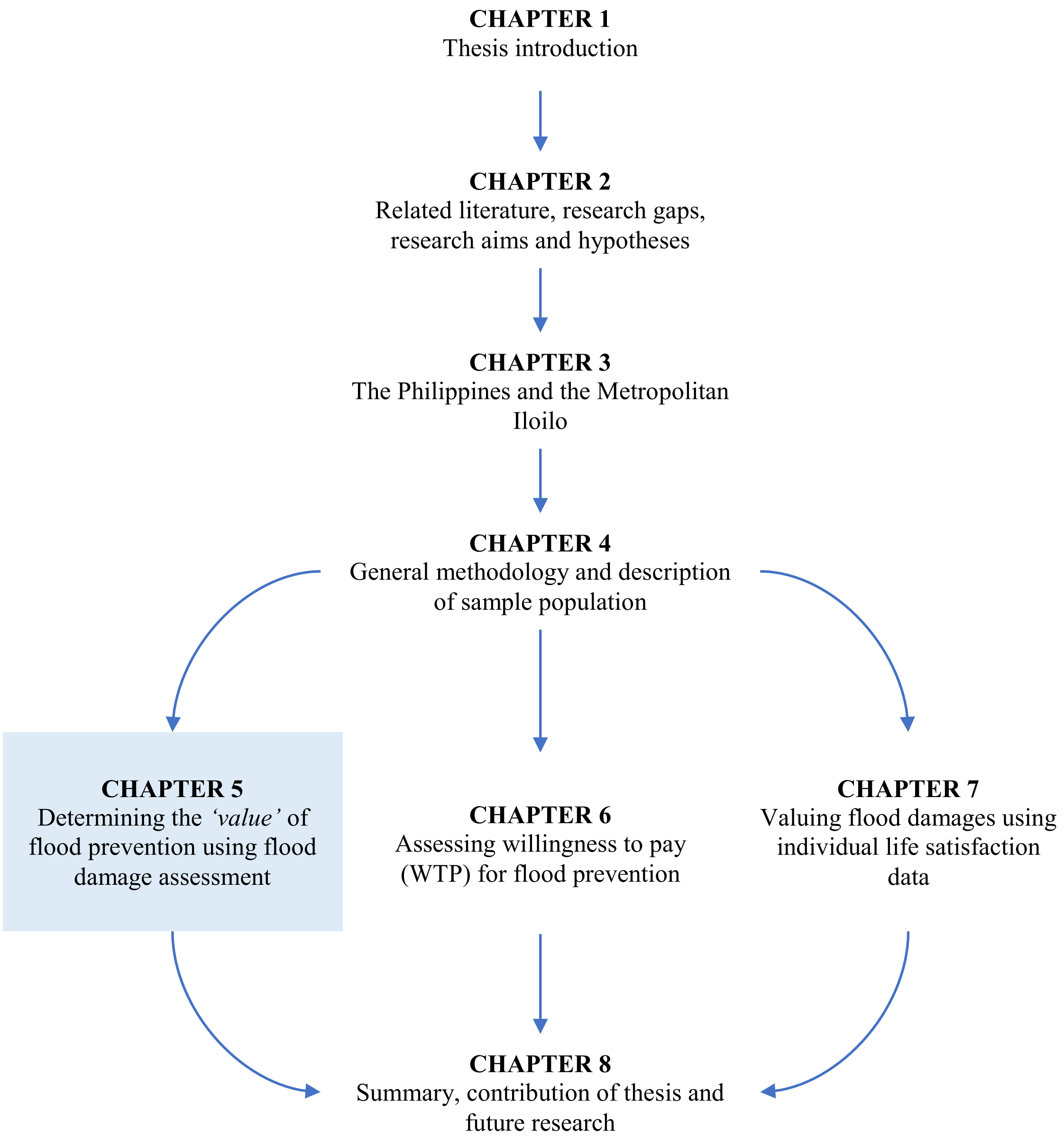
- A quantitative approach, in particular a social survey, was adapted to gather information about household flood damages, peoples' LS, WTP for flood prevention and likely determinants of flood damages, WTP and LS.
- FGDs and a pre-test survey were executed to develop the questionnaire. Initially, a questionnaire was drafted, including predictors of LS based on the current literature. Representatives from manufacturing, agriculture and fisheries, services and tourism industries participated in eight FGDs, verifying the appropriateness and validity of the questions. The questionnaire was then tested on residents (n=50) in the case study region (described in Section 2.2).
- Following the FGDs and pre-test survey, the questionnaire was revised in order to include the following information relating to the LS approach:
  - The term *'overall life satisfaction'* was used in the questionnaire as it was described as synonymous with *'happiness'* and other terminology associated with well-being.
  - The scale rating from 0 (not satisfied) to 100 (very satisfied) for overall LS was used.
  - Information regarding financial and employment security, religion, relationship with family and friends, overall health status and neighbourhood characteristics were identified to be important determinants of LS; perceptions about these determinants were collected in the survey.
- Also, following the FGDs and pre-test survey, the questionnaire was revised in order to include the following information relating to the CV method (for WTP):

- The WTP responses were elicited using a payment card (PC) approach. Intervals were carefully developed by first using an open-ended WTP question and summarising the most-stated amounts to make up the final intervals for the PC.
- The *barangay* (community) council was the most trusted institution to handle the payments, while residents indicated that voluntary payments (i.e. donation) was the most appropriate way of asking households to contribute.
- A hypothetical scenario was used to evaluate WTP of households for preventing their flood damages.

- The questionnaire was translated into the local dialect, Hiligaynon and checked for word consistency using back translation, i.e. translating the questionnaire to Hiligaynon and translating it back into English.
- Data were collected from various households in all administrative units of the MI, comprising of six towns and one city. A multistage sampling (geographically stratified random and purposive sampling) was executed. The geographically random stratified sampling was suited for households at varying distances to/from rivers and coasts.
- Enumerators underwent survey training prior to the survey execution.
- Overall, survey data were collected from 600 household heads/spouses/employed family members from 33 communities in all towns and cities of the MI region. The sample was 0.37% of the total household population in the region.
- A large proportion of respondents believed that the existence and quality of rivers and forests were associated with floods.

- There were differences with perceptions regarding financial and employment security, religion, relationship with family and friends, overall health status and neighbourhood characteristics.

Thesis outline



5: Determining the *'value'* of flood prevention using flood damage assessment

Chapter outline

Research aims addressed in this chapter

General aim: Determine how much damage (to households) could be avoided if one were able to prevent flood.

Specific aim #1: Collect household level data on actual flood damage from a five-year period.

Specific aim #2: Collect and estimate flood damages in different damage categories (e.g. property damages and employment losses) and across households with different socio-demographic characteristics.

5.1. Chapter introduction

The economic value for preventing flood damages can be estimated in many ways. One of these techniques is to estimate flood damages, which is a straightforward approach that considers *'associated damages that can be prevented if flood is avoided'* (Section 2.2 in Chapter 2). The monetary impacts from floods have been well-studied and have been examined at various levels (e.g. individual, town or national stages) and in various categories (e.g. individual, household or industry types) (Smith 1981; Merz et al., 2010). I calculated the economic *'value'* of flood prevention using market prices as proxies. Studies, however, relating to flood damage assessment share common shortcomings:

1) The estimation of monetary impacts from floods dominate over non-monetary impacts of floods (Merz et al., 2010). In the field of economics, estimating *'value'* for intangible goods is not new (Landefeld & Seskin, 1992; Hanley & Spash, 1993; Sendi, Gafni, & Birch, 2002), with stated preference techniques (such as CV) used to do so. In other disciplines, intangible and/or indirect flood damages have been separately explored mostly in the discipline of psychology, and predominantly looking at emotional impacts (Jarungrattanapong & Manasboonphem, 2011; Azad et al., 2013; Crabtree, 2013).
2) Most flood damage assessments do not incorporate longer run effects to individuals/households or economic sectors. For instance, there is evidence from the psychological perspective, that flood (or any disaster) may have long-lasting emotional consequences for individuals (Smith et al., 2011; Crabtree, 2013).

3) Most flood damage assessments looked at a single flood event, usually events which are disastrous. There is a need to understand flooding over a longer period (including years in which flooding did not occur, or considering impacts from multiple floods across several years).
4) Most estimations of flood damages rely on national/regional governments' estimation, which frequently focus on disadvantaged sectors (e.g. agriculture) and/or on poor households. Little is known about flood damages across households with different socio-demographic levels, more especially in the Philippines.

Given these gaps, I gathered information about various flood impacts (both tangible and non-tangible), over a long period (i.e. five years) across various levels of socio-demographic characteristics. In this chapter, I also discuss whether various estimates of flood damages described in Chapter 2 match with my empirical findings.

5.2. Questionnaire design, flood damage model and data analysis

To measure associated damages from floods, a series of questions were asked in section two of the questionnaire, shown in Figure 5.1 (survey execution and related processes are outlined in Chapter 4).

12) Note the extent of flooding and list the **non-financial loss(es)** (psychological effects) from each flooding event **in the last 5 years** as well as the **financial loss(es)** to your household (in terms of damage to personal property, loss of employment opportunities and other expenses e.g. transportation, medicine, drinking water, etc.). Take note that flooding damages are from flood waters (discard any other damage you may have incurred from the flooding event(s), like wind damage).

Approximate time of flood (month, year)	Were you living here at the time?	How deep was the flood water in the street outside your house/home/apartment block (in centimetres, cm)	Was your life or safety threatened and/or that of your family or close relative or friend? Not threatened … Very threatened					Damage to personal properties, land and/or crops (₱)	Loss of employment opportunities and/or opportunities to grow/catch food (₱)	Additional expenses (₱)
			1	2	3	4	5			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
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	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			

Figure 5.1: Flood damage estimation questions used in the main survey (English translation).

First, I asked respondents to identify, recall and list any flood event(s) that their household had experienced since June 2008, noting where they lived when the flood happened. Second, for every reported flood event, respondents were asked to indicate the depth (in centimetres) of floodwater in their houses (enumerators brought metric rulers to aid respondents to establish their approximation of the flood water). Next, respondents were asked to rate the level of threat which each flood event posed for their family members, relatives and/or close friends: a score of *'one'* indicated not threatened, while *'five'* indicated very threatened. The rating represents intangible impact from flooding (i.e. non-monetary flood damage). Fourth, monetary flood damages were elicited for each flood event. Specifically, reported monetary losses of long-term residing households from flooding were segregated into three damage categories:

1) Damages to personal properties;
2) Losses of employment opportunities (e.g. loss of income due to inability to go to work because of community difficulties during flood); and
3) Other related damages.

Prior to commencing analysis, I made the following calculations:

I focused on respondents who had lived in their current community since June 2008 (n=524) i.e. long-term residents. This ensured that my analysis of WTP (Chapter 6) and LS (Chapter 7) would not have other confounding factors (such as differences attributable to changed residence) complicating the analysis. It thus allowed me to learn more about the impact of floods within a community and to make valid comparisons across communities. Safety scores were recoded in such a way that *'zero'* signifies respondents experienced no threat to self and/or to family and/or friends. This means that ratings of 1, 2, 3, 4 and 5 where recoded as 0, 1, 2, 3 and 4; where a *'zero'* rating indicates *'not threatened'* while *'4'* indicates *'very threatened.'*

I assigned a value of zero for floodwater depth, safety scores and monetary flood damages to residents who had not experienced any flooding at all. If respondents provided some information about a particularly flood event (e.g. reported a safety threat) but left other information about that same flood event blank, then the missing value associated with particular type of damage (e.g. employment losses), for that particular flood event, was replaced with zero. I calculated the *'monetary flood damage'* associated with each flood event by adding damages from: personal/property damages, employment losses and additional damages.

I also looked at the mean, median and maximum values of each type of flood damage, for each household. For example, if a household reported three events with three different flood water depths of 1cm, 1cm, and 2cm, then: mean household flood water depth was 1.33cm; median household flood water depth was 1cm; and maximum household flood water depth was 2cm. I used the same approach to estimate mean, median and maximum impacts for the non-monetary damages (i.e. safety threat scores).

5.3. Results and discussions

This section presents exploratory analysis of different flood impacts (e.g. frequency of floods, mean ratings of threat of safety, mean depth of floodwater at home and mean monetary flood damage). Subsequently, I discuss the *'value'* of flood prevention using estimates from flood damages.

5.3.1. Descriptive statistics

As it was pointed out in Chapter 2, damages to household property and loss of employment opportunities are examples of direct and indirect tangible damages respectively. Safety threat scores capture intangible and direct costs. Table 5.1 presents the descriptive statistics of these impacts while Appendix I shows the distribution of these impacts.

The first set of analyses examined how many floods each household experienced from June 2008 to June 2013. The *'average'* household experienced one flood (mean = 1.09; median = 1) during the previous five years – although some reported no flood (minimum of 0) and some reported as many as 5 (maximum of 5). Appendix J shows the distribution of mean reported flood incidences across communities. Respondents from the communities of Sta. Monica (in the town of Oton) and Binangkilan (in the town of Sta. Barbara) reported no flooding. Other communities in the town of Oton, namely San Antonio (≈3) and Poblacion West (2.4), however, recounted a higher number of floodings. Households living in the communities of Guinobatan Norte in Leganes experienced, on average 2 floods since 2008. While, households living within Iloilo City experience, on average between 1 and 2 floods during that period (Molo Boulevard: ≈1; Bo. Obrero: ≈1; Sto. Niño Sur: ≈2; and Buntatala: ≈2).

Table 5.1: Summary statistics of household flood impacts (in the last five years), n=524.

Flood impacts	Household mean	Household median	Std. Dev.	Minimum	Maximum
Number of floods experienced	1.09	1	1.11	0	5
Monetary flood damages (in ₱)	8,791	633	25,771	0	350,000
Safety threat scores	1.03	0.71	1.16	0	4
Flood water depth (in cm)	56.64	22.5	87.40	0	585

The Centre for Research on the Epidemiology of Disasters (CRED) recorded flood events in the Western Visayas region from 2001 to 2013 (Figure 5.2). The Centre classified floods as either riverine or coastal floods. Residents were most severely affected in the year 2012. There was one flood event recorded between 2001 and 2009 and one in 2013. In 2011, there were four floods but the total recorded impact (both for number of people affected and deaths) was relatively small compared to 2012. Specifically, in 2012, there were three floods, but they were more disastrous. From their data, it seems that households were flooded at least once a year and the level of their damages were not declining over time. Comparing this information with my results, it seems that households reported fewer floods than the recorded flood incidences by institutions. Although, not statistically tested here due to lack of appropriate data, this may have been attributed to recall or social desirability bias as discussed in Section 2.4.

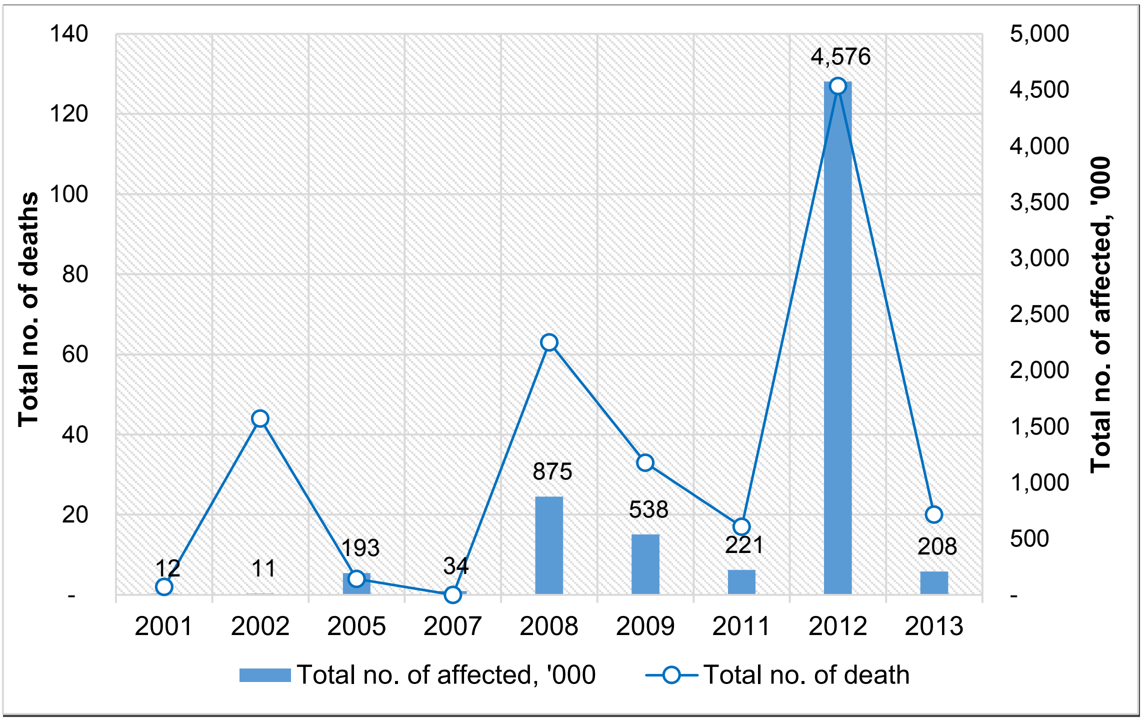


Figure 5.2: Impacts of floods in the Western Visayas Region, 2001-2013. Data retrieved from EM-DAT (Guha-Sapir, Below, & Hoyois, 2015).

Respondents indicated an average threat score of 1.03 across all of the flood events they experienced, on a scale 0 (no threat) to 4 (very threatened); with a standard deviation: 1.16. But there were also respondents who had never felt any threat at all (minimum = 0), and some who had felt very threatened (maximum = 4). Therefore, the evidence suggests that the intangible damages from flood are non-trivial for at least some households.

Appendix K presents the mean number of floods and the corresponding level of mean safety threat scores. As expected, with no flood experiences, respondents from Sta. Monica and Binangkilan, reported no threat to their safety. Also, Sta. Rita, where respondents experienced minimal flood (average of 0.3 floods) reported there was no safety threat either. Some communities, San Antonio (1st) and Poblacion West (3rd), with a very high incidence of floods, had relatively low safety threat scores, (with mean values of 1.9 and 2.0, respectively), but *barangays* in the town of Pavia, which experienced frequent floodings, had high (mean) safety threat scores.

Unfortunately, there are no official national or regional records of trauma loss associated with disasters/floods, such as in Thailand (Jarungrattanapong & Manasboonphem, 2011) and in the UK (DEFRA, 2005). Nevertheless, there are accounts of trauma or emotional strain from floods in the MI area (PIA, 2009). Halili-Jao (2008) described the situation in Pavia during the 2008 flood:

> *"Apparently, the town of Pavia about 12 kilometers from the city was the most affected as the connecting streams coming from big rivers in central Iloilo covered almost all barangays. Flood water rose up so quickly that rescuers were quite delayed in helping people in rooftops, atop buses in terminal area, flooded homes and treetops due to impassable roads, damaged bridges and six to eight feet, high polluted water on highways. Many elderly persons, including women and children, were missing and were believed to be carried by the rushing flood"* (para. 5).

Household/respondent had around 57cm of water through their home each time they were affected by flood; but the distribution of responses was highly skewed with a standard deviation equal to 87.40. The highest average depth recorded per household was around 584cm. There were some respondents who had never had any water through their house at all (minimum = 0cm). The distribution of reported floodwater depth per location is presented in Appendix L. Households from Iloilo City seem to have experienced high levels of floodwater. For example, Molo Boulevard, Buntatala and Tabuc Suba experienced between 260cm and 132cm of floodwater for every flood event. The city is prone to flooding (as discussed in Chapters 3 and 4); just a few hours of rain can generate widespread flooding - Tanza Bonifacio, Tanza Timawa, front of Lapaz market area, John B. Lacson Molo area, Molo Plaza, General Luna Street, Atrium area, Mabini and Quezon streets, Tanza area and the Iloilo Mission Hospital area (RMN Iloilo, 2014).

As noted earlier, monetary flood damages were categorised into three – property and/or other personal damages, employment losses and additional damages. The average household incurred about ₱8,790 (US$195) each time they were impacted by a flood. The median value was much lower at ₱633 (US$14). Some households recorded no monetary losses while others experienced losses as much as ₱350,000 (US$7,778) in a single flood. As shown in Figure 5.3, property and/or other personal damages comprised the majority of monetary damages (65% of the total). It was followed by employment losses at 25% and the 10% remainder for additional damages.

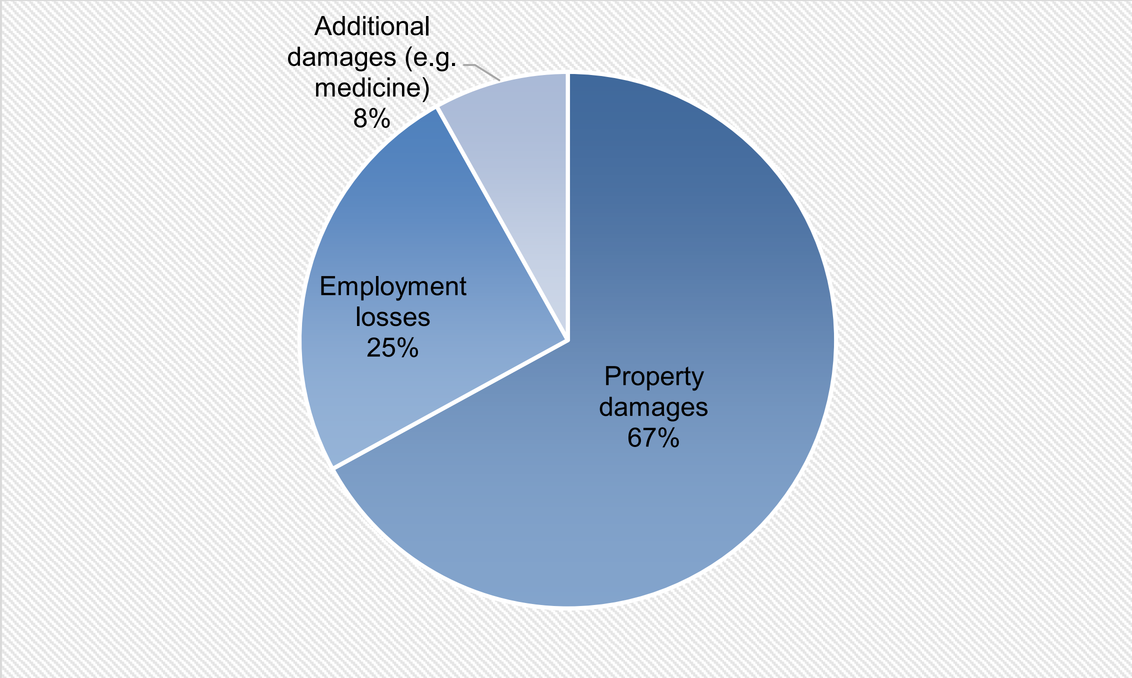


Figure 5.3: Distribution of monetary flood damage categories.

Figure 5.4 shows the mean flood damage (bars) and the mean number of floods (line) experienced by households in each sampled community. It clearly shows that frequent floods do not automatically translate into high (monetary) damages. Some of these differences likely reflect topography, but some may also be due to flood mitigation programs already undertaken within communities.

Iloilo City has a floodway (4.8 kilometres long, 82 metres wide) that was built under the Iloilo Flood Control program financed by the Japan International Cooperation Agency (JICA) through the Department of Public Works and Highways (DPWH) (Dodman et al., 2010; Iloilo City Government, 2011). Dodman et al. (2010) examined the Iloilo Flood Control Project and concluded that it is one of the programs that advocate successful partnerships between governments, other institutions and communities. This probably explained the low damages from the communities in Iloilo City: Bo. Obrero and Sto. Niño Sur. But Molo Boulevard, a coastal community in the city, reported one of the highest mean flood damage.

Elevation may also play an important role in the frequency of flood events and the monetary damages incurred during these events. Table 5.2 presents a summary of the elevation levels of all sampled communities. Also shown in Appendix J are the elevations from the sea level of the most and least flooded communities. The most flooded communities (San Antonio, Guinobatan Norte, Poblacion West and Buntatala) have elevations of 10 to 18 metres. Elevations were high in Sta. Monica and Binangkilan, where residents experienced no floods for the last five years.

Table 5.2: Elevation from sea level across locations, in metres.

Towns/Barangays	**Towns/Barangays**	**Towns/Barangays**
Oton	**Cabatuan**	**Sta. Barbara**
1. San Antonio - 10	12. Bacan - 68	24. Lanag - 44
2. Sta. Rita - 28	13. Tabucan - 58	25. Palag-on - 38
3. Poblacion West - 12	14. Salacay - 67	26. Binangkilan - 32
4. Sta. Clara - 38	15. Sulanga - 65	27. Agutayan - 38
5. Sta. Monica - 32	16. Baluyan - 69	28. Duyan-duyan - 64
6. Botong - 10	17. Ayaman - 72	29. Buyo - 37
San Miguel	18. Talanghaun - 63	**Iloilo City**
7. Igtambo - 49	19. Tiring - 56	30. Ungka I - 20
8. San Jose - 27	**Leganes**	31. Bo. Obrero - 8
9. Barangay 12 - 47	20. Buntatala - 10	32. Sto. Niño Sur - 25

Towns/Barangays	Towns/Barangays	Towns/Barangays
Pavia	21. Guinobatan-Norte - 18	33. Molo Boulevard - 12
10. Aganan - 35	22. Cagamutan-Norte - 14	
11. Tabuc Suba - 25	23. Lapayon - 30	

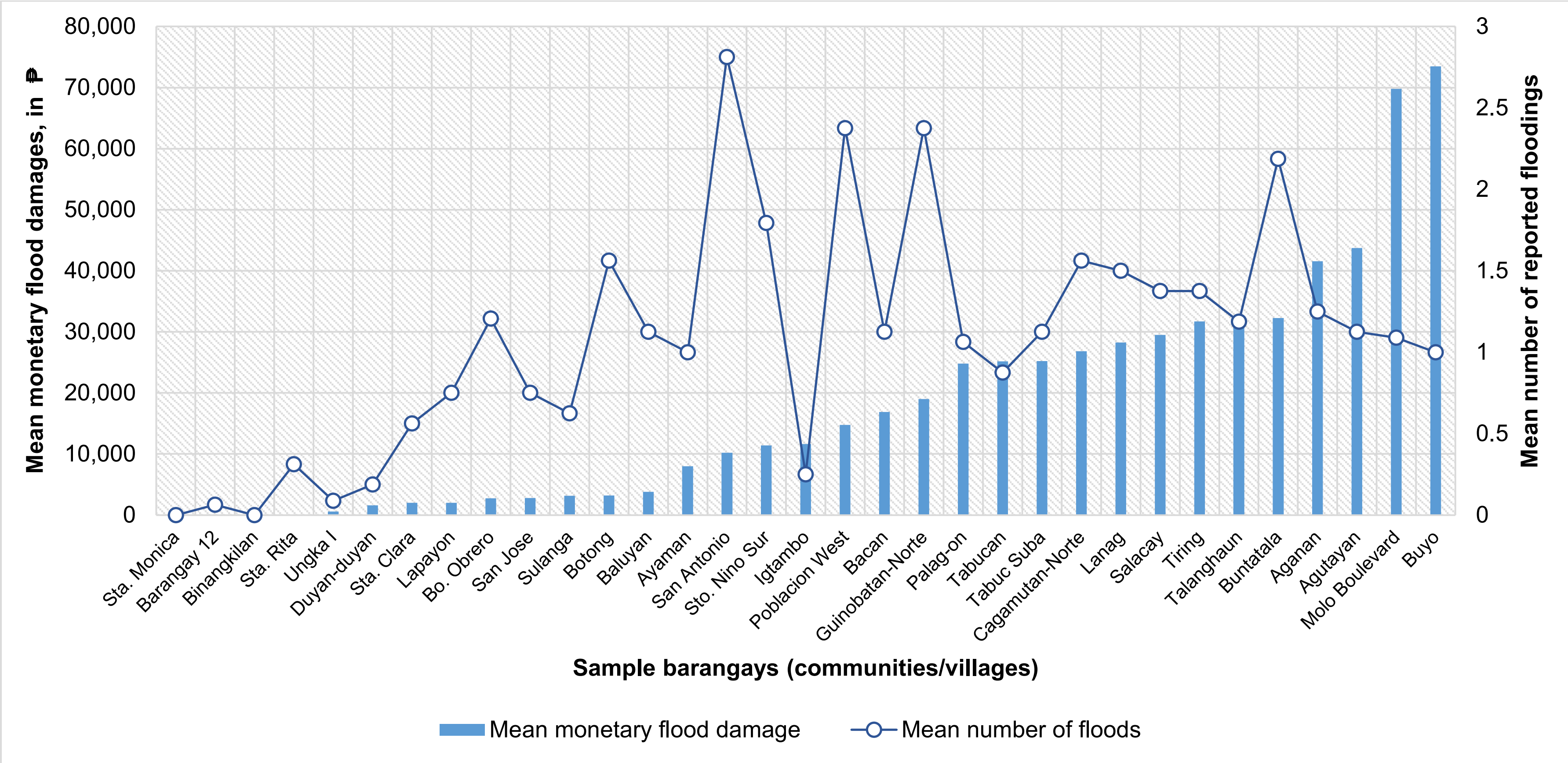


Figure 5.4: Mean monetary flood damage and number of floods per household, June 2008 to June 2013.

5.3.2. Monetary flood damages across socio-demographic characteristics

As discussed in Chapter 2, different types of households are likely to be differently impacted by flooding – either because of different exposure rates (more frequent or deeper floods), or because the damages incurred differ (e.g. more property affected). In Figure 5.5, I present the mean monetary flood damages for households of different types (according to household income, number of income sources and size of the household). I will discuss these in more detail in Chapter 6, where I describe the models that explicitly consider factors affecting flood damages and WTP using multivariate approaches; but for the moment, I look for simple patterns in the data.

First, it is obvious that monetary flood damages are related to income but the relationship is not linear. For instance, some of the richest households (with income in the 7th, 9th and 10th deciles) reported significant monetary damage, but other households in the 6th and 8th income deciles had low damage compared to households in the lowest income deciles (1st and 2nd).

The bars in Figure 5.6 show estimates of annual mean monetary flood damage while the line shows annual mean monetary flood damage as a percentage of annual household income, for households in different income deciles. What is interesting in this data is that the mean monetary flood damage of rich households was high compared to poor households, but the mean monetary flood damage as a percentage of income was relatively higher for the poorest households (e.g. for the first decile, mean monetary flood damage was 13.9% of income). This accords with findings from previous studies (discussed in Sections 5.3.1 and 5.3.2 and in Chapter 2). Poor households are constrained in undertaking activities that may help minimise flood damages (Wisner et al., 2004; Lopez-Marrero, 2010) – they may, for example, be unable to afford to purchase houses that are built other than in flood prone areas. This issue is explored in further detail in Chapter 6, when assessing determinants of WTP and of flood damage.

Second, households with three or more sources of income reported low monetary damages. This observation corroborates existing literature. Households with multiple income sources or occupations have been shown to adapt more to changes in climate because risks are redistributed (Defiesta & Rapera, 2014; Cinner, et al., 2015).

Finally, reported damages increase with household size. The highest mean damages were found in households with 7 and 10 members. Again, this conforms to findings from other researchers. For example, Zhai et al. (2006) and Crastes, et al. (2014) found that large households are often impacted more – hypothesising that this is because they usually have belongings that are of high-value; while Gaillard et al. (2008) showed that households with more family members needed more food and other supplies during floods.

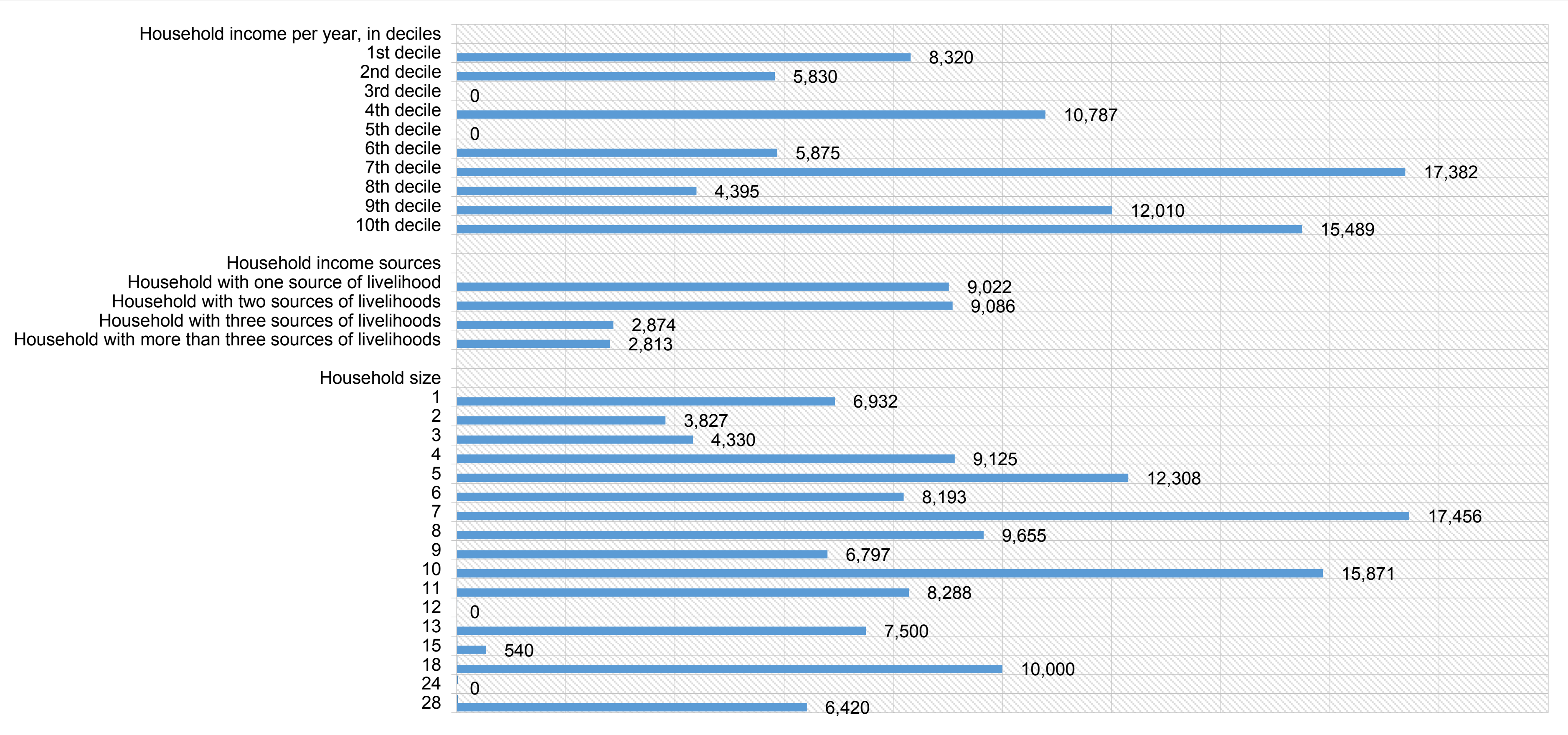


Figure 5.5: Mean monetary flood damage across selected household characteristics, in ₱.

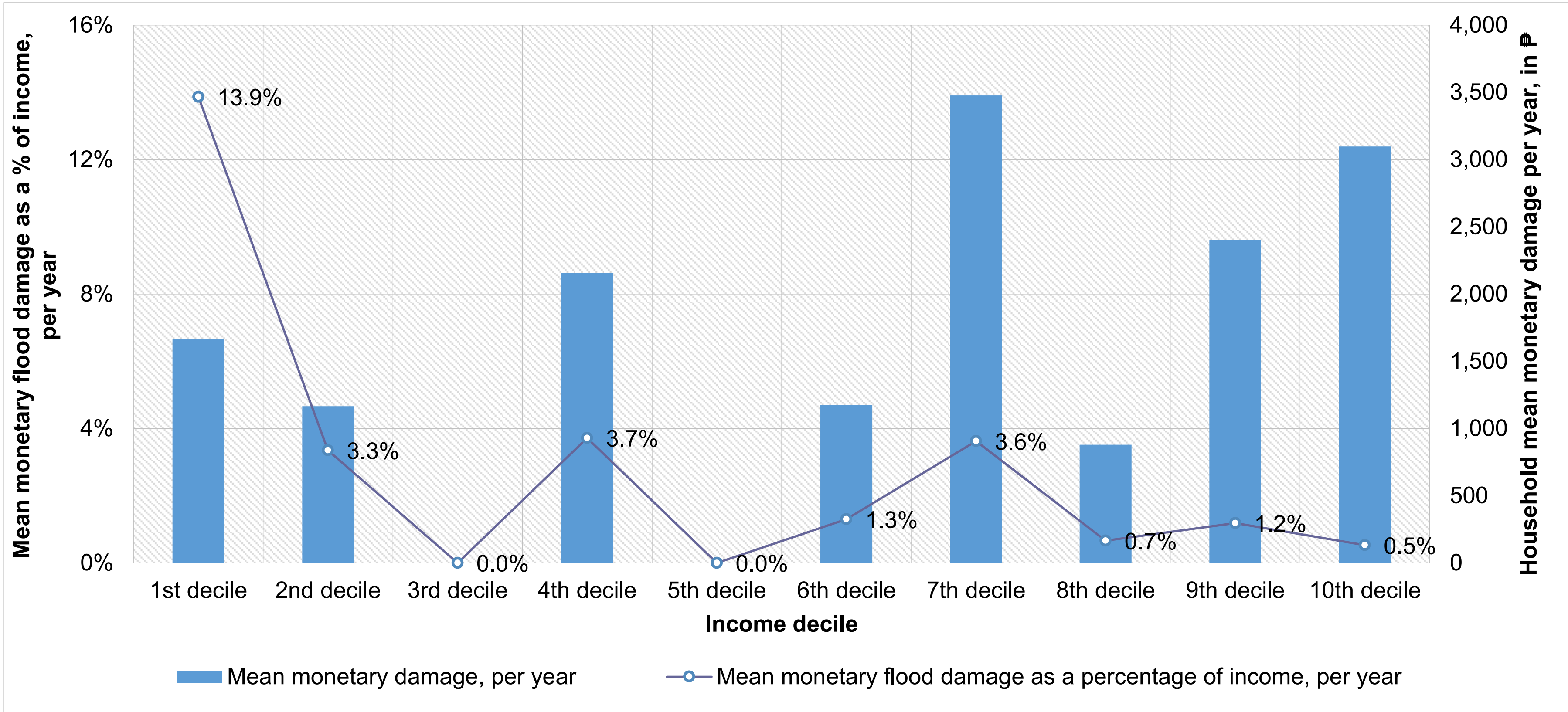


Figure 5.6: Annual mean monetary flood damage as percentage of annual household income, n=524.

5.3.3. Mean annual flood damages

From the previous section, I concluded that a multivariate analysis is needed in order to statistically determine the factors affecting flood damages. This section presents estimates of mean annual damages and regression analysis to determine which of the socio-demographic characteristics presented earlier significantly affect mean flood damages.

The flood damage estimates presented in Section 5.3.1 relate to all households who had lived in the same *barangay* for the focal period (n=524). Table 5.3 presents flood damage estimates for the sub-samples used to undertake a more complete analysis of WTP and LS in Chapters 6 and 7. These samples are a subset of the entire population, since respondents frequently decline to answer each and every question in a survey. The analyses undertaken in Chapters 6 and 7, thus include only respondents who answered all questions relating to WTP (n=387) and LS (n=407).

Using these figures, the *'average'* household incurred ₱8,791 (US$195) damage per flood event in the five-year period.

Table 5.3: Mean monetary flood damages across sample sizes used in this thesis (in the last five years and in ₱ rounded to the nearest '000).

Sample size	Household average	Household median	Std. Dev. of household average	Minimum	Maximum
All sample (n=600)	₱18,491	₱2,050	49,099	0	700,000
All long-term residents (Chapter 5, n=524)	₱8,791	₱633	25,771	0	350,000
WTP sample (Chapter 6, n=387)	₱14,130	₱1,600	35,175	0	350,000

Sample size	Household average	Household median	Std. Dev. of household average	Minimum	Maximum
LS sample (Chapter 7, n=407)	₱9,012	₱6,645	27,082	0	350,000

As mentioned in Section 2.2, other studies have estimated household flood damages. With this information, I also compare my estimate - Table 5.4. I found that their estimates of household flood damages are higher than my estimates (i.e. ₱1,758 or US$39 per household per flood event). This is also true even for household damage for less developed countries such as Bangladesh (US$190) and Vietnam (US$200 to US$935). The differences in the estimates are likely due to the fact that previous studies have estimated damages associated with a single flood event – often an extreme one. Instead, I have considered damages over a five-year period, which includes periods in which no floods occurred.

Table 5.4: Summary of monetary flood damages from other related studies.

Reference	Study area/ damages included in the estimation	Method used	Monetary flood damage estimate
Brouwer et al. (2009)	Bangladesh Loss of crops, medical treatment, damage to houses etc.	Self-reported damages that cover floods in 2004	US$190 (BDTK11,950) per household for 2004 flood event (mean)
Navrud et al. (2012)	Vietnam Physical damages such as loss of their house, crops and livestock	Self-reported damages that cover floods in 2007	US$200 (VND3.8M) per household for 2007 flood event (mean)
Botzen and van den Bergh (2012)	Netherlands Damages to building and home contents	Expected flood damages using probability of flooding and flood damages from	US$75,000 (€70,500 per household per year (mean), expected value (US$1 = €0.94 in 2008)

Reference	Study area/ damages included in the estimation	Method used	Monetary flood damage estimate
		household survey	
Lantz et al. (2012)	Canada Damage/repair costs to their buildings, landscapes and personal items; costs of any preventative measures taken prior or post flood; the cost of lost work time; temporary displacement costs; medical costs; etc.	Self-reported damages that cover single flood event in 2007	US$1,927,500 for 2005 flood event (aggregated for household sector) US$939.8 per household (own calculations using total household surveys = 2,051)
Bui and Nguyen (2014)	Vietnam Damage to property (e.g. house, amenities), production (e.g. loss of crops/poultry, etc.) and disease (e.g. medical costs)	Self-reported damages that cover floods in *'recent years'*	US$935 (VND20.58M) per household per year (mean) (US$1 = VND22,000 in 2013)
Wijayanti et al. (2015)	Indonesia Damages to households because of floodwater depth and length of flooding	Self-reported damages that cover single flood event in 2007	US$247 (IDR2.4M) per household per year (median)

Besides determining the determinants of flood damages in a multivariate setting, I also use regression analysis to explore potential non-linearity effects. I ran five models (Models 1 to 5) with various functional forms (Table 5.5) some of which allow for non-linear effects. The different specifications seem to indicate that some form of non-linearity is present, i.e. logging flood damages is defendable. In terms of determinants of flood damage, I find that multiciplity of household occupations (at least 4 occupations) is consistently significant across functional forms (not sensitive). Adults and children are only significant in Models 3 and 4 (with LN flood damages as dependent variable). An additional child in the household will generate an increase of mean flood damage by approximately 7%. Moreover, an additional adult member will increase mean flood damages by around 4%.

Table 5.5: Flood damage model with various functional forms.

	(1) Flood damage (linear)	(2) Flood damage (semi-log)	(3) LN flood damage (semi-log)	(4) LN flood damage (double log)	(5) LN flood damage (polynomial)
Household monthly income	1.71e-06	-	-5.76e-06	-	4.24e-06
LN household monthly income	-	0.154	-	-0.070	-
No. of income sources (categorical)					
1	0.356	0.411	-0.277	-0.267	0.340
2	-0.094	-0.033	-0.220	-0.220	-0.166
3	0.140	0.155	-0.152	-0.168	-0.033
More than 3	-25.296***	-24.906***	-19.055***	-19.773***	-25.415***
No. of children in the household	0.049	0.044	0.071***	0.074***	0.002
No. of adults in the household	0.147	0.127	0.038*	0.041**	0.005
Constant	8.226***	6.918***	1.649***	2.174***	8.745***
AIC	6384.205	6383.259	2403.465	2404.174	6385.891
Log-likelihood	-3183.102	-3182.630	-1192.732	-1193.087	-3183.946
Sample size (N)	453	453	453	453	453

5.3.4. Damages that could be avoided if all floods could be prevented

Using the 2012 household population of the MI region (Table 3.3 in Chapter 3), 160,477 people, and assuming that the *'average'* damage experienced by households across the entire region is closely approximated by the *'average'* damage experienced by our the sampled households, it seems that a *'perfect'* flood mitigation program (one capable of preventing all flood damages to all households in the region) could prevent on average, ₱282M (US$6M) of damages each year. This is one way of thinking about the *'value'* of flood mitigation: it could potentially save in excess of US$6M per year, each and every year into the future.

Assuming that to be the case, it is possible to estimate the Present Value (PV) of total damages over a 50-year period[20]:

$$PV = \sum_{n=1}^{50} \frac{6}{(1+\delta)^n} \qquad \textit{Equation 5.}$$

where,

PV is the present value of flood the a stream of flood damages (i.e. US$6M per year) prevented during the economic life of the levee banks (50 years), and

δ is the discount rate.

The real interest rate (r) is often used in lieu of δ, which, using the Fisher equation *(1 + r) = (1+i)/(1+π))* can be approximated as:

$$r = i - \pi \qquad \textit{Equation 6.}$$

where,

r is the real interest rate,

[20] I assume that the levee banks have an economic life of 50 years, as similar to the Iloilo Flood Control program (JICA, 2013).

i is the nominal interest rate, and

π is the rate of inflation.

The *Bangko Sentral ng Pilipinas* (BSP – the central bank of the Philippines) has recorded nominal interest rates for early 2016 (BSP, 2016) at around 2 to 10%. The rate of inflation (core inflation) was at 2.1% end of December 2015 (PSA, 2016). This indicates that real interest rates were between 0 and 8%. I, thus, calculate the PV of the flood damage using a discount rate of 0% and also a discount rate of 8% - yielding estimates of between US$86M to US$300M.

This suggests that expenditures on flood mitigation programs of as much as US$86M could be *'justified'* – as long as those expenditures could prevent all future flood impacts, like those measured in this survey, from occurring. As briefly mentioned in Section 3.3, the Iloilo Flood Control project that covered Iloilo City and Pavia and was loaned from the Japanese government cost US$61M to construct. So there is some *prima facie* evidence to suggest that current expenditures on flood control are, perhaps, too low.

These findings, must be, however, interpreted with caution because certain assumptions were used. First, as noted in the previous chapter, my sample is not representative of the region's population. For example: ninety one per cent of the adult population in the region is younger than 59 years old, compared to 79% in the sample; 51% of the population in the region is female, compared to 71% in the sample and the average annual household income in the region is ₱143,000 (US$3,178) compared to ₱120,000 (US$2,667) in the sample. So my extrapolations from sample means to population estimates must be treated with caution.

Second, I assumed that the population of the MI region is constant throughout the next 50 years, no maintenance costs of the infrastructure, as well as the same level of flood damages and probability of flood events in the next 50 years. As discussed in Chapters 2 and 4, these assumptions will not be met. IPCC (2014) and the World Risk Report (UNU-EHS, 2014), for example, predict that typhoons and flood events will become more frequent and more intense in this part of the world. Then, we would expect that required investments would be larger than US$6.2M if floods become more frequent and more severe. To some extent, these estimate are thus likely to <u>understate</u> the damages that could occur in the future (i.e. underestimate the *'value'* of flood prevention programs). That said, and as discussed earlier, we know that these estimates are not *'true'* measures of the welfare cost of floods – hence the importance of considering other valuation techniques such as the CV and LS methods.

5.4. Chapter summary

This chapter has examined flood damages of households in the Metropolitan Iloilo (MI), Philippines. In most recent studies in damage (or cost) assessments (Chapter 2), flood damage has been measured by looking at market prices or price equivalent of these damages. The flood damage assessment measured associated damages, using market prices for damages foregone if floods are prevented, therefore allows for an estimate of the *'value'* of flood prevention.

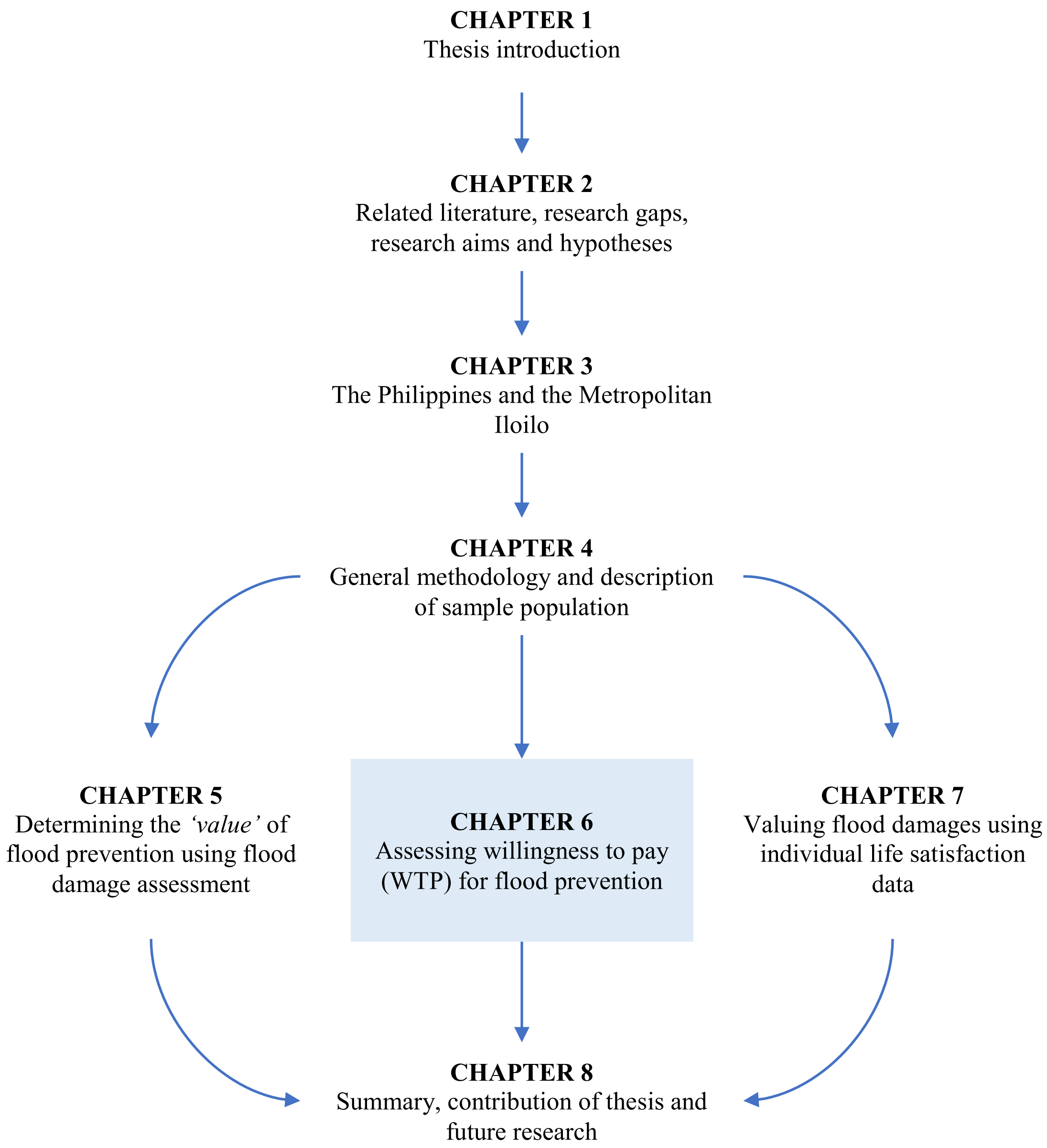
Households living in the area since June 2008 were identified as long-term residents and were used to calculate damages (n=524). Various household flood experiences were reported by the respondents, including: frequency of flood events experienced; depth of water in the house; level of safety threat to self and/or family/friends; and monetary flood damages (e.g. damages to properties and employment losses).

I found that the *'value'* of flood prevention was ₱8,791 (US$195) per household for five years of flood, which is equivalent to around ₱1,758 (US$49) per household per year. In aggregate, the total flood expenditure of the MI region could be up to US$6M per year, but that figure would increase if floods become more frequent and more severe in the future.

Despite its exploratory and direct nature, this chapter offers information regarding to how many local governments in the MI region should be spending on flood prevention. The results suggest that governments could spend up to US$6M per year on flood mitigation programs – provided of course, they were effective. These expenditures would be worthwhile financially from a whole-of-community perspective, because the money saved by preventing floods each year would exceed the annual cost of mitigation programs.

Besides the estimation of flood damages, the key strength of this chapter is that it studies flood damages to households over a longer period (not a single event) and that is includes indirect/direct and tangible/intangible damages as well as a breakdown of flood damages to household characteristics. The findings in this chapter provide an exploratory understanding of various factors influencing flood damages, which is important in the next chapters which analyse the association between damages, WTP and LS. For example, poor households suffer more from flood events compared to wealthier counterparts; while households with multiple sources of income have lower flood damages. Moreover, it highlights the fact that there is a non-linear relationship between income levels and mean monetary flood damages and household size and mean monetary flood damages. Of course, the generalisability of these associations will be further tested in Chapters 6 and 7, where I examine WTP and LS, respectively.

Thesis outline



6: Assessing willingness to pay (WTP) for flood prevention

Chapter outline

Research aims addressed in this chapter

General aim: Determine how much households are willing to pay to avoid future flood damages.

> Specific aim #1: Determine the drivers of willingness to pay (WTP) by collecting household level data on actual flood damage from a five-year period.
>
> Specific aim #2: Assess WTP for flood prevention and analyse the relationship between WTP and other variables (including actual flood damage, attitudes and other socio-demographic variables).
>
> Specific aim #3: Estimate the demand for flood prevention in the Philippines, after having controlled for interrelationships.

6.1. Review of the research gaps in the non-market valuation and flood literature

In Chapter 2, I provided a brief overview of three different methods of assessing the *'value'* of flood prevention (the implication being that expenditure on flood prevention should be less than or equal to that *'value'*). This chapter focuses on one of those techniques, namely: the contingent valuation (CV) method. Although numerous CV studies and other non-market valuation techniques have sought to assess the *'value'* of flood prevention, it is worth noting that:

1) Most flood valuation studies have been done in developed countries (mostly in Europe and America) and it is not clear if results can be transferred to other

contexts – for example, in socially disadvantaged areas, such as the Philippines.

2) Most CV studies of flood have either used data relating to a single (extreme) event in their assessments (determining WTP to prevent a single extreme event), or they have assessed flood damages using secondary regional-level flood damage data (e.g. flood depth, taken from GIS database), drawing inferences from that data about the likely impact on individuals (rather than measuring impacts directly). It is not clear if results from these studies are transferrable to the more general problem of determining how much should be generally spent on flood prevention.
3) Few CV studies of WTP to prevent flood damage have controlled for interrelationships between key drivers of WTP (e.g. income) and determinants of flood impact/damage (also likely to be associated with income). Estimates of WTP may thus be under or over estimated.

Following the shortcomings from previous flood valuation studies, I conducted a CV study to determine household WTP for flood prevention and assess its drivers, while controlling for the interrelationships of these factors. One of the hypotheses that will be tested in this chapter is whether households who experience more frequent floods and/or with larger mean flood monetary damages are willing to pay more for flood prevention than other households. Another set of hypotheses that will be tested is whether WTP is positively influenced by (1) *awareness about flood risk, positive attitudes towards conservation and credibility and trust in the feasibility of the WTP scenario; and* (2) being male, highly educated, member of a household with high income, more children or high occupational diversity

Moreover, I also wanted to know if there are positive and correlation between positive perceptions and attitudinal statements relating to flood risk etc. and whether they are characterised by households that are rich, high occupation diversity, more adult/children members as well as individuals who are older, female, and highly educated.

6.2. The explanatory variables used in the WTP model

In Chapter 2, I explained how I developed a conceptual model, which helped me to frame my survey questions, to develop and test the questionnaire in Chapter 4. In this section, I discuss how I used the data to estimate WTP.

Since perceptions/attitudes are crucial in estimating WTP for flood prevention (Section 2.3.1 in Chapter 2), my questionnaire thus included a statement arguing that the respondent should pay for the project, i.e. the victim pay principle as proposed by Arrow et al. (1993). Respondents may not agree to this principle, arguing they already pay taxes and therefore have a right to a flood free community (Fuks & Chatterjee, 2008). Eight other statements relating to perceptions/attitudes towards flood risk were also included in the questionnaire:

1) There are other more important problems that need funding (other than preventing/avoiding flooding in my neighbourhood).
2) I do not care about the problems of flooding.
3) I do not believe that the funding would produce the promised levee banks (the money might just be wasted).
4) I do not believe that the levee banks would prevent future flood damages.
5) I do not believe that my household is at risk of being flooded.

6) I am not prepared to pay anything to minimise flooding unless others pay too.
7) I want to prevent the risk of flooding in my community.
8) I want future generations to enjoy a flood-free community.

A potential problem may occur when some respondents have an inclination to give high scores in general, while other respondents give low scores (Schaeffer, 2000; Krumpal, 2013). Hence, I normalised the statement scores by dividing each statement score by the mean respondent score, over all eight statements. The standardised statement scores were used in my succeeding analyses.

Earlier in Section 2.3, I reported that the perceived trustworthiness of the institution [the *barangay* (community) council] included in the CV scenario that should handle the donations may influence WTP responses. I included a question in the survey asking respondents whether they trusted the *barangay* council to handle the donations appropriately. From that variable I constructed a payment vehicle dummy, which was coded 1 if respondents trusted collection through the *barangay*; 0 otherwise.

Also discussed in Section 2.3 were the socio-demographic factors that influence WTP – both directly and indirectly. I included income, age, gender and education as well as some household characteristics (e.g. number of adults and children in the household, household income).

6.3. The methodological approach used to analyse data

Formally, I set up the WTP model as:

WTP = f (flood risk, perceptions/attitudes and socio-demographic characteristics)

As discussed in chapter 2, socio-economic factors are likely affect (1) flood damage, (2) the probability of being flooded, and (3) perceptions/attitudes towards floods and about the hypothetical scenario. So simply enlisting variables representing flood damage, probability of flood, socio-demographic characteristics and separate regressors in a WTP model could run the risk of introducing problems such as endogeneity. I thus undertook:

1) A preliminary look at data to see if patterns exist (i.e. sub-models);
2) An assessment of correlations/relationships between perceptions/attitudinal variables;
3) An assessment of the relationship between perceptions/attitudes and socio-demographic characteristics;
4) An assessment of the relationship between probability of flood, flood damage and socio-demographic characteristics;
5) An assessment of the relationship between the acceptable method of payment (i.e. collection through the *barangay*) and socio-demographic characteristics;
6) Developing a model that controls for the relationships where appropriate; and
7) Estimation WTP model.

Section 6.6 presents the details of the analyses and the corresponding results.

6.4. Background / preliminary analysis of data

Most of the 600 respondents had lived in the community for more than five years (n=524); the remainder had not and were thus excluded from this analysis to ensure all flood-damage estimates referred to people who had lived in the same place for the entire assessment period. Of those, 387 respondents answered all questions relevant to the analysis; the incomplete questionnaires were omitted. My discussion, thus, focuses on that subset of 387 respondents. Table 6.1 provides descriptive statistics for core variables.

In Chapters 2 and 4, I discussed the payment card and how I used this to collect WTP responses. Figure 6.1 presents the distribution of WTP. The Skewness and Kurtosis Test for Normality (p-value = 0.000) also confirmed non-normality of mean monetary flood damage. Moreover, the standard deviation of the dependent variable was greater than the mean; suggesting that WTP responses were over-dispersed and the Skewness and Kurtosis Test for Normality revealed that this variable was not normally distributed (p-value = 0.000).

Table 6.1: Description and basic statistics of variables used in the willingness to pay (WTP) models, n=387.

Variables	Description	Mean	Std. Dev.
WTP (dependent variable)	Willingness to pay for flood prevention, per year, in ₱	136	213
Flood damage (mean)	Calculated by adding each household's self-reported estimates of monetary flood damages in the last five years then dividing by the number of (self-reported) floods [includes different types of damages (e.g. property and employment losses)], in ₱	14,130	35,174
Probability of flood	The number of flood events (self-reported) experienced by the household in the previous five years	1.2	1.1
Years of education	Number of years in formal education	9.8	3.0
Age	Age, in years of respondent	47.0	15.1

Variables	Description	Mean	Std. Dev.
Gender (female)	Gender of respondent - 1 female, 0 male	0.7	0.5
LN household income	Yearly income per household, calculated as described in Chapters 4 and 5.	9.8	1.0
Income sources	The number of sources/ sectors/ activities (self-reported) in which all members of the household earn income (e.g. from agriculture, retail)	Household with one source of livelihood (72.4%) Household with two sources of livelihoods (24.0%) Household with three sources of livelihoods (3.1%) Households with more than three sources of livelihoods (0.5%)	-
Children	Number of children in the household	1.9	1.6
Adults	Number of adults in the household	3.3	2.0

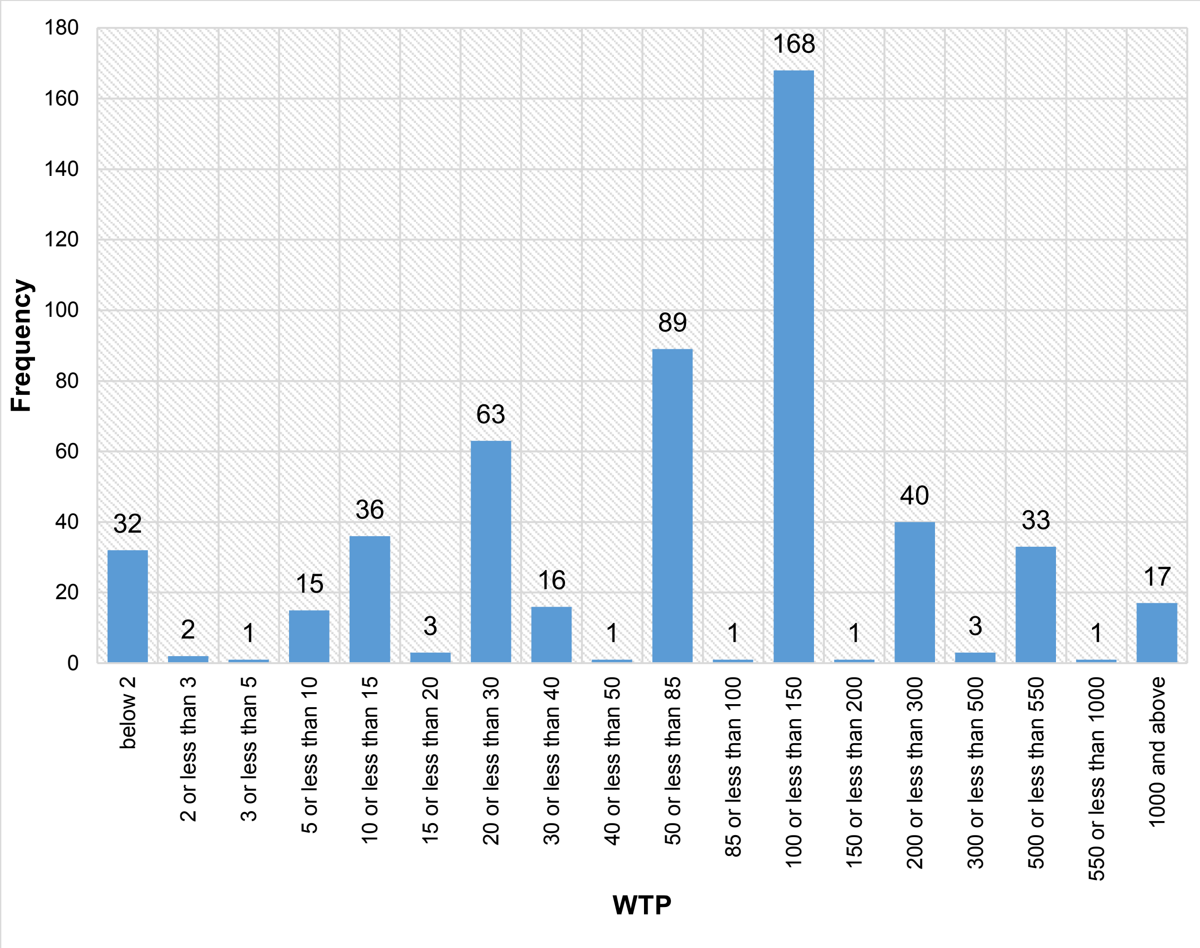


Figure 6.1: Distribution of willingness to pay (WTP) responses, n=387.

Reported flood damages, discussed in Chapters 4 and 5, were transformed to yearly damages and were compared to annual WTP responses.

Figure 6.2 provides an examination of the distribution of WTP, annual number of floods (i.e. probability of floods in the five year period divided by five years), annual flood damage (i.e. annual mean flood damage * annual number of floods) to household income deciles. The figure shows that the annual number of floods dropped with income, while the annual flood damage decreased with income – at least for the first eight income deciles; not the 20% richest households. The annual flood damage as a percentage of income dropped with income. In addition, when WTP is expressed as a percentage of annual flood damage incurred, the value rises with income – except for the top two income deciles.

My findings for the bottom 80% of the income ladder are consistent with the literature on disaster risk, which argues that households with higher income will have lower flood damages. In Chapters 2 and 5, I argued that rich households have higher adaptive capacity than poor households, implying mitigation activities are easier and more available (Wisner et al., 2004; Lopez-Marrero, 2010). The examination also matches observations in other studies (Zhai et al., 2006; Navrud et al., 2012). For example, in Bangladesh, poor residents experienced both higher inundation levels and higher flood damages (Brouwer et al., 2009). This finding also corroborates with Navrud et al.'s (2012) flood damage findings in Vietnam, who reported that poor households were most affected. However, my findings do not extend to the 20% highest income earning households, whose annual flood damage increases. This is not a result of a rise in the annual number of floods, which continues to decline. Rather it must be a result of an increase in their mean flood damage – potentially because they have more assets. Perhaps my sample design (which not only focused on the poor, but also included the rich in the region) allowed to reveal this finding as opposed to studies that focus on the poor and middle income earning households.

It is interesting to note that the annual flood damage in my study is smaller (mean: US$101 and median: US$42) than in the Vietnamese study (US$200). Poor households (those in the lowest income decile) in my sample, incurred annual flood damages amounting to approximately 12% of their income, while poor Vietnamese households experienced damages of 27% of their income for one extreme flood incident. The difference is likely to be attributable to the difference in focus: one extreme flood event versus the annual impact during a five year period.

Figure 6.2 also shows that WTP as a percentage of income is decreasing for richer households, nonewithstanding their higher ability to pay. As discussed in Chapter 2, many studies have explored the relationship between WTP and ability to pay and found a positive association between the two (Zhai & Ikeda, 2006; Navrud et al., 2012) and results have been robust in CV studies (Carson et al., 2001). A multivariate rather than a bivariate analysis is required to tease out these effects.

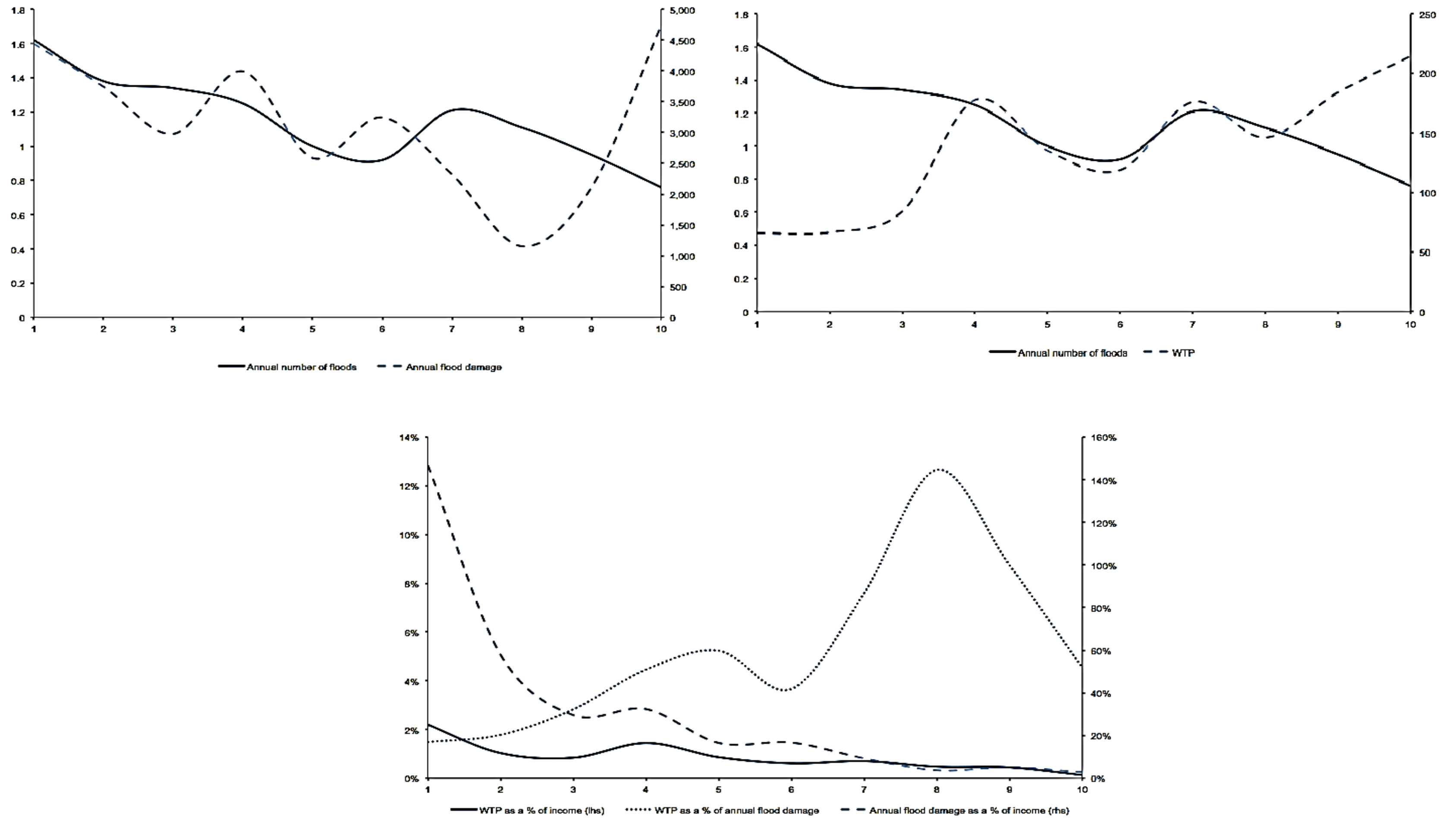


Figure 6.2: Annual number of floods, annual flood damages and WTP by household income deciles.

6.5. Estimating the WTP model

6.5.1. Characterising perceptions/attitudes

Table 6.2 presents descriptive statistics for the variables relating to perceptions and attitudes.

Table 6.2: Perceptions/ attitudinal statements used in the WTP model - standardised score from level of agreement, measured by a five-point scale (1 strongly disagree, 5 strongly agree).

Description	Mean	Std. Dev.
There are other more important problems that need funding (other than preventing/avoiding flooding in my neighbourhood).	0.5	0.7
I do not care about the problems of flooding.	1.2	0.5
I do not believe that the fund would produce the promised levee banks (the money might just be wasted).	1.0	0.7
I do not believe that the levee banks would prevent future flood damages.	1.0	0.6
I do not believe that my household is at risk of being flooded.	1.1	0.6
I am not prepared to pay anything to minimise flooding unless others pay too.	1.0	0.6
I want to prevent the risk of flooding in my community.	1.1	0.3
I want future generations to enjoy a flood-free community.	1.2	0.2

I used Principal Component Analysis (PCA) (Jolliffe, 2002) to look for patterns / clustering of responses (Table 6.3) from the eight attitudinal statements. This indicated that responses could be categorised into three factor components, accounting for 83% of the total variation. Six statements loaded onto the first component, which accounted for the majority of the variation (57%).

Table 6.3: Principal component analysis (PCA) of perceptions and attitudes about floods.

Variable	**Factor 1:** Scepticism	**Factor 2:** Attitude towards community flood prevention	**Factor 3:** About flood-free community in the future
I want to prevent the risk of flooding in my community.		-0.7	
I want future generations to enjoy a flood-free community.			0.6
There are other more important problems that need funding (other than preventing/avoiding flooding in my neighbourhood).	0.4		
I do not care about the problems of flooding.	0.4		
I do not believe that my household is at risk of being flooded.	0.4		
I am not prepared to pay anything to minimise flooding unless others pay too.	0.4		
I do not believe that the fund would produce the promised levee banks (the money might just be wasted).	0.4		
I do not believe that the levee banks would prevent future flood damages.	0.4		
Eigenvalue	4.6	1.3	.73
Variance explained (cumulative %)	57%	74%	83%

I combined responses to these statements by calculating the average of their scores after converting negative statements to positive statements and standardising the scores. This first component is, henceforth, termed *'scepticism'* as it measures the respondent's level of scepticism about flood risk and initiatives (e.g. levees) to control flood. Stern et al. (1995), Kobori (2009) and Lo (2013) found that behaviour towards (environmental) conservation might partly depend on individual's motives, expectations and institutional settings. Natural disasters, such as floods, are described as events that have low probability of occurrence, but are damaging (Botzen et al., 2013) and individuals respond differently based on their assessment of the risk. The results also corroborate the idea that perceptions of risk and disaster impacts (e.g. from climate change) may influence adaptation behaviours (Grothmann & Patt, 2005). The measure of scepticism included statements that controlled for strategic bias (Fuks & Chatterjee, 2008), such as believing that flood mitigation programs should be provided by the government, or expectations that neighbours should pay as well.

The second factor was dominated by responses to a question about the desire to contribute to community flood prevention (*'I want to prevent the risk of flooding in my community'*), while the third factor was dominated by responses to the question about the desire to protect future generations. In some valuation studies in the Philippines, Filipinos were found to respond in line with socially acceptable behaviours. When asked about their WTP for conservation of Tubbataha Reefs National Marine Park, a significant proportion responded that they wanted to preserve the park for future generations (Subade & Francisco, 2014). Also, Filipinos signified that there was a need to *"manage and protect the watershed in order to have a sustainable supply of water as well as lessen the effects of natural disasters"* in a watershed valuation study (Calderon et al., 2013, p. 15). Some flood valuation studies (Glenk & Fischer, 2010; Bliem & Getzner, 2012; Marzetti & Brandolini, 2012) found that perceptions of donation and conservation may influence WTP. Subsequently, I used polychoric factor analysis (which handles a mix of continuous and binary variables) to investigate the relationship between the *'scepticism'* variable and the other two, unrelated statements and the payment vehicle dummy variable. Results suggested that these four variables should be treated separately (Table 6.4). In other words, responses to statement (1) genuinely reflect altruistic/ community values; statement (2) reflects bequest values while the other statements (3) and (4) separately reflect scepticism about flood risk and initiatives to control flood and attitudes with respect to payment vehicle, respectively.

Table 6.4: Polychoric analyses between perceptions and attitudes about floods and trust to payment vehicle.

Variable	Factor 1
1) Attitude towards community flood prevention - I want to prevent the risk of flooding in my community.	0.62
2) Belief about flood-free community in the future - I want future generations to enjoy a flood-free community.	-0.29
3) Scepticism	0.17
4) Perception about acceptability of payment vehicle (dummy)	-0.47
Eigenvalue	0.72
Variance explained (cumulative %)	83%

6.5.2. Identifying and controlling for relationships between attitudes and socio-demographic variables

As discussed in Section 2.3.1, research suggests that some of my perceptions/attitudinal variables [‘*scepticism,*’ ‘*attitude towards community flood prevention*’, ‘*belief about flood-free community in the future*’ and ‘*perception about acceptability of payment vehicle*’ (dummy)] were likely to be related to socio-demographic characteristics of respondents. To check, I firstly used the Durbin-Wu-Hausman test (DWH augmented regression test) for endogeneity in STATA, to test whether the four items were correlated with individual-level demographics (age, gender [female dummy] and years of education). When doing so, I specified an equation describing each attitudinal variable (for example ‘*scepticism*’) as a function of age, gender (female dummy) and years of education. I saved the predicted values

(PV) from the regression and re-ran the broader (WTP) model to test if the PVs were statistically significant.

After running four separate regressions and DWH tests, I found no evidence that individual characteristics affected factors under the perceptions category: *scepticism* (χ^2 prob. = 0.3), *'attitude towards community flood prevention'* (χ2 prob. = 0.7), *'belief about flood-free community in the future'* (χ^2 prob. = 0.4) and *'perception about acceptability of payment vehicle'* (dummy) (χ^2 prob. = 0.9).

6.5.3. Identifying and controlling for relationships between flood risk and socio-demographic variables

Earlier, I hypothesised that the number of floods experienced and mean monetary flood damage may be influenced by socio-demographic characteristics, most notably income (Figure 6.2). I tested for endogeneity by using a set of socio-demographic characteristics (e.g. household income, income sources, number of children and adults in the household) and regressed these variables against: (a) the number of floods experienced and (b) mean monetary flood damage. Similar to the analysis described above, I retained the residuals from these regressions and used them within the DWH test. The tests suggested that endogeneity is not a problem for the variable *'probability of flood'* (χ^2 prob. = 0.96), but is when considering *'flood damage (mean)'* (χ^2 prob. = 0.00).

Thus, I sought an instrumental variable (IV) to control for this problem (Podsakoff et al., 2012); specifically looking for one that is conceptually a stronger predictor of damage, but is not correlated with WTP (Greene, 2008).

I proposed to use the financial budget of the local government unit (LGU) in which the respondents live, sourced from the Philippine Statistics Authority (2015), as an IV. Aside from regular expenses for basic needs/social services in communities, the LGU budget in the Philippines is used for disaster mitigation activities, such as investments in public safety (e.g. police) and health (e.g. hospital and emergency response).

Conceptually, a relationship between the LGU budget and flood impact is plausible for at least two reasons. First, disaster risk reduction programs are generally ineffective in the Philippines, raising the importance of mitigation activities for which the LGU budget can be used. In Benson's (2009) review of disaster risk reduction in the Philippines, she noted that local governments usually lack the funding, capacity and interest for disaster risk reduction programs, which has brought about ill-functioning programs. She narrated that in one city in the country, the local DCC is only functioning during disasters. In addition, during local planning, most budgets are usually allocated to dredging of rivers, basketball courts, waiting sheds and community markers (Benson, 2009). Second, the LGU budget sustains a key mitigation activity: medical infrastructure. For example, in 2006, during and after the floods in Sagrada, Philippines, access to medicine for flood-acquired health conditions (e.g. skin infection from faecal matter in floodwaters) was an important concern in the community (Gaillard et al., 2008). Appropriate medicine was not readily available in their communities and expensive in town centres. In 2013, at least 28,689 individuals were injured in the Philippines as a result of Typhoon Haiyan (NDRRMC, 2014) and lack of medical infrastructure and clean water were two of the major problems in the evacuation (Yu-Tzu, 2013).

Therefore, households who are living in towns, with better facilities/services, may have received assistance that minimised their flood damages (Gaillard et al., 2008). These services are especially crucial to poor families, because they lack the financial assets to recover from disasters (Wisner et al., 2004).

I introduced the LGU budget in the analysis in million pesos and in logarithmic form (mean = 5.1 and standard deviation = 1.3). I formally tested if this variable was a good IV for monetary flood damage using two steps. First, I ran an interval regression for WTP against all exogenous variables [flood damage (mean), probability of flood, socio-demographic characteristics (LN household income, income source categories, numbers of children and adults in the households, age, gender), scepticism, *'attitudes towards the community flood prevention'*, *'belief about flood-free community in the future'* and *'perception about acceptability of payment vehicle'* (dummy)]. I then saved the residuals from this regression. Using Pearson correlation, I tested for association between the residuals and the potential IV (i.e. LGU budget). I found no significant association between the residuals and LGU budget (p-value = 0.99). Second, I ran a negative binomial regression for monetary mean flood damage, as a function of some socio-demographic characteristics (e.g. household income, income sources categories, number of children and adults in the household) and the IV (LGU budget). Results showed that the IV was a significant predictor of mean monetary flood damage (p-value = 0.04). Consequently, LGU budget is an appropriate IV for the flood valuation model.[21]

[21] Alternatively and assuming linearity of WTP, I conducted a two-stage regression (2LS) to test the appropriateness of using the LGU budget as an IV in the model [Durbin (p-value = 0.01) and Wu-Hausman (p-value = 0.0144)] and the strength of LGU budget as an IV (STATA's first-stage

The choice of model specification was informed by the discussion in Section 6.4 about the nature of WTP and mean flood damages. I used a negative binomial regression during step two because the mean monetary flood damage data was overly dispersed, i.e. its variance was larger than the mean (Institute for Digital Research and Education, 2015). I used interval regression for step one because the WTP responses were derived from a payment card, with *'intervals.'* Hence, ordinary least squares (OLS) regression would have been inappropriate.

6.5.4. Estimating the final models

I used two-stage regression techniques. In the first stage, I regressed the IV and socio-demographic characteristics against mean monetary flood damages.[22] Predicted values were retained and used in the second stage, as detailed below:

$$\textit{(First stage) flood damage (mean)}_i = \beta_0 + \beta_1 \textit{ LN household income} + \beta_2 \textit{ income sources (categorical variable)} + \beta_3 \textit{ children} + \beta_4 \textit{ adults} + \beta_5 \textit{ LN local government unit budget (IV)} + \varepsilon_i \quad \textit{Equation 7.}$$

where,

'household income' is reported gross annual income of households,

'income sources' is a categorical variable indicating the number of household income sources,

'children' is the total number of children (i.e. individuals 16 years old and below) in the household,

command, p-value=0.08). Since LGU budget was uncorrelated with WTP but highly correlated to mean flood damage, town budget is an appropriate IV for the flood valuation model.

[22] Although I concluded that non-linear regression is more preferable in mean flood models, in the first stage regression, I assumed linearity.

'adults' is the total number of adults (i.e. not classified as children) in the household,

'local government unit budget' is the annual budget of towns/city, and

ε is the unobserved random variation.

$$\textit{(Second stage)}\ WTP_i = \beta_0 + \beta_1\,\textit{probability of flood} + \beta_2\,\textit{flood damage (mean) (predicted value)} + \gamma_i\,(X) + \varepsilon_i \qquad \textit{Equation 8.}$$

where,

'probability of flood' is the reported number of flood events,

'flood damage (mean) (predicted value)' is the set of predicted values generated from Equation 7,

X is a vector of other independent variables containing:

- individual characteristics [e.g. years of education, age, gender (female dummy)];
- household characteristics (e.g. LN income, income sources categories, number of children and adults in the households);
- '*scepticism*';
- *'attitude towards community flood prevention'*;
- *'belief about flood-free community in the future'*;
- '*perception about donation' (payment vehicle dummy)*; and

ε is the unobserved random variation.

Negative binomial and interval regressions were used in the first and second stage regressions, respectively.

I found that the determinants of WTP were heteroskedastic, so for both regressions, I used robust standard errors in order to address this bias.[23] I report results from the two-stage interval regression below.

6.6. Results

Results from the (first-stage) negative binomial regression of flood damage (mean) and the (second-stage) interval regression of WTP are presented in Table 6.5 and Table 6.6, respectively. The overall fit of the first-stage regression model is good as the likelihood-ratio-chi-square is statistically significant. Flood damages were higher in communities with lower local government budgets than in communities with higher budgets; there was also a statistically significant association between flood damages and occupational multiplicity in households.

The likelihood-ratio-chi-square for the second-stage model was also statistically significant. Mean monetary flood damage had a positive and significant relationship with WTP. Socio-demographic characteristics, such as household income, education, number of adults in the family and occupational multiplicity, were also significantly associated with WTP as well as respondents' scepticism.

[23] Scatter diagrams of WTP determinants and Breusch-Pagan Test (χ^2 prob. = 0.00) suggest presence of heteroskedasticity.

Table 6.5: Negative binomial regression model for flood damage (mean) (first-stage).

Determinants of mean flood damage	**Coefficient**	**Std. Errors (robust)**	**Prob.**
LN household annual income	0.1306	0.139	0.348
Income sources			
Household with one source of livelihood	*reference*	*reference*	*reference*
Household with two sources of livelihoods	-0.20	0.267	0.939
Household with three sources of livelihoods	-1.127	0.520	0.030**
Household with more than three sources of livelihoods	-1.461	0.883	0.098*
Children	0.056	0.069	0.417
Adults	0.106	0.066	0.107
LN local government unit budget (IV)	-0.277	0.113	0.013**
Constant	9.02	1.622	0.000***

n = 387
Log pseudo likelihood = -2871.2352
Prob > chi2 = 0.0106
AIC = 5760.470
BIC = 5796.096

Note: ***Significance at the 99% confidence level; **Significance at the 95% confidence level; *Significance at the 90% confidence level.

Table 6.6: Interval regression model for willingness to pay (WTP) (second-stage).

Determinants of WTP	**Coefficient**	**Std. Errors (robust)**	**Prob.**
Mean flood damage (predicted values)	0.006	0.003	0.022**
Probability of flood	-2.039	10.322	0.843
Years of education	11.106	4.163	0.008***
Age	0.134	0.828	0.871
Gender (female)	-25.852	28.931	0.372
LN household annual income	44.757	15.681	0.004***
Income sources			
Household with one source of livelihood	*reference*	*reference*	*reference*
Household with two sources of livelihoods	-53.992	27.223	0.047**
Household with three sources of livelihoods	41.961	84.287	0.619
Household with more than three sources of livelihoods	-155.143	65.396	0.018**
Children	-8.653	8.439	0.305
Adults	-15.716	8.943	0.079*
Scepticism	-28.026	8.340	0.001***
Attitude towards community flood prevention	-4.871	48.321	0.920
Belief about flood-free community in the future	-80.291	85.955	0.350
Perception about acceptability of payment vehicle (dummy)	4.928	52.471	0.925
Constant	-296.575	225.896	0.189

n = 387
Log pseudo likelihood = -1190.4195
Prob > chi2 = 0.0002
AIC = 2414.839
BIC = 2482.132

Note: ***Significance at the 99% confidence level; **Significance at the 95% confidence level; *Significance at the 90% confidence level.

6.7. Discussions

This chapter set out with the aim of calculating recurring flood damages and determining WTP of Filipino households for preventing flood damages. The significant determinants of WTP were consistent with a priori expectations and were empirically similar to related studies.

6.7.1. Determinants of flood damage (mean)

The relationship between the LGU budget (IV) and mean flood damage was – as expected – statistically significant (Wisner et al., 2004; Gaillard et al., 2008; Yu-Tzu, 2013). Chapter 2 discussed occupational multiciplity (represented by the number of income sources in the model) and how it may influence flood damages and WTP, through redistribution of flood risk to various occupations (Reardon & Vosti, 1995). This means that those households with more sources of income have lower exposure and vulnerability to flood impacts. I confirmed this statistically significant negative association between mean flood damage and income sources. Households with multiple income sources have lower flood impacts. I also expected a positive link between the number of adults in the household and mean flood damage, following Zhai and Ikeda (2006), Lo (2013) and Crastes et al. (2014), however, could not confirm this link.

My study did not identify household income as a significant determinant of mean flood damage. For instance Zhai et al. (2006) and Navrud et al. (2012) found that poor households have experienced more flood and higher monetary damages. In Figure 6.2, I showed a similar development for the 80% poorest households. However, mean flood damage increased for the 20% richest households – possibly because they have more assets to lose in a flooding event. I conjecture that their inclusion in the analysis – as opposed to the studies above who may have focused on low and middle income households – neutralises the generally found negative relationship between income and mean flood damage.

6.7.2. Determinants of WTP for flood prevention

Results from the second-stage regression confirmed ideas from previous flood valuation studies. I found a positive association between WTP and household income, which is well supported in the flood valuation literature (Shabman & Stephenson, 1996; Zhai & Ikeda, 2006) and more recently in Lo (2013), Ghanbarpour and Saravi (2014), Bui and Nguyen (2014), Crastes et al. (2014) and Veronesi et al. (2014). That is, those respondents with more income were willing to pay more for flood prevention. As expected, more educated individuals indicated higher WTP (Fuks & Chatterjee, 2008; Brouwer et al., 2009; Navrud et al., 2012). There was a statistically significant negative relationship between the number of adults in the household and WTP; however, number of adults was an insignificant determinant of flood damage. Some studies (Zhai & Ikeda, 2006; Bui & Nguyen, 2014) found that the number of adults in the household influenced household‘s WTP for evacuation; while some found that household size do not influence WTP at all (Hammit et al., 2001). The findings also showed a positive relationship between mean flood damage and WTP. This result was in agreement with the findings of Brouwer et al. (2009) in Bangladesh; Botzen and van den Bergh (2012) in the Netherlands; and Bui and Nguyen (2014) and Navrud et al. (2012) in Vietnam. Strong evidence of a negative association between scepticism of respondents and WTP was also found (Glenk & Fischer, 2010; Marzetti & Brandolini, 2012; Bliem & Getzner, 2012).

I also found that occupational multiplicity reduces both mean flood damage (first stage regression) and WTP (second stage regression). To the best of my knowledge, diversity of income sources was seldomly explored in flood valuation studies (Brouwer et al., 2009) but its impact on adaptation was considered in some studies (Reardon & Vosti, 1995; Defiesta & Rapera, 2014; Cinner, et al., 2015). It is possible that income diversification implies that a smaller share of income is derived from sources that are interrupted by floods, hence why mean flood damage is lower. Related to this, occupational recovery may be slow in resource-dependent jobs, because of a lack of capital/credit (e.g. rural/small-denomination or credit from friend/family) (Defiesta & Rapera, 2014), or means of production (e.g. damage of crop or boats destroyed) (Cutter et al., 2003). Therefore, coping with flood damage is harder for households who have just one (resource-dependent) livelihood, compared to households who have more than one livelihood at their disposal, as this raises the chance that an income source is available that is not interrupted by the flood (e.g. remittance). This is in line with Brouwer, Akter, Brander and Haque (2007) who find that high-income families in Bangladesh, who lived close to a river have more damage, also tend to adapt better to floods because they have multiple occupations, unlike poor households that have *"fewer opportunities to engage in multiple economic activities"* (p. 325). Hence why households who rely on one or few income sources are willing to pay more for flood prevention.

6.7.3. The WTP for flood prevention

Using the coefficients from the second stage regression, I calculated the predicted WTP at the average monetary flood damage (₱14,130 divided by five years = ₱2,826). For this flood damage level, WTP is approximately ₱108 or US$2.4 per household per year. In order to determine whether responses are reasonable, I compared this estimate to the WTP of other similar flood valuation studies and to the cost of flood levees and the local government unit (LGU) annual budget – although comparisons must be interpreted with caution because my scenario and the study context are different to those in other flood valuation studies. One clear difference with my CV scenario was the measurement of flood damages over a longer period of time (i.e. a five-year span), as opposed to concentrating on an extreme event; thus, my estimate captured recurring effects of floods on households.

First, it is relevant to compare my findings to the findings from the studies of Brouwer et al. (2009) and Navrud et al. (2012). Using Bootstrap and Turnbull estimations and reported flood damages from the 2004 extreme flood event in Bangladesh, Brouwer et al. (2009) estimated WTP at between US$4.3 (BDTK27) and US$6.0 (BDTK37.6) per household, per year. Reporting household flood damages from the 2007 extreme flood event in Vietnam, Navrud et al. (2012) estimated that Vietnamese households were willing to contribute 6.73 person days for flood prevention. Using information about conversion rates from their study (i.e. VND15, 000 per one person (labour) day and VND19, 000=US$1), I can deduce that households' WTP is approximately US$17.7 per year. My estimate was close to theirs – albeit at the lower end. The difference in WTP between these two studies and mine may be attributed to the difference in measurement of flood damages. I was interested in the average annual flood damage over a five-year period, rather than flood damages of a specific event, which I highlighted at the beginning of this chapter. As a consequence, the average annual flood damage in my analysis US$75.4 (₱3,391) is lower compared to US$190 per household (BDTK11,950) for Bangladesh (Brouwer et al., 2009) and US$200

(VND3.8M) for Vietnam (Navrud et al., 2012). This may explain the lower WTP in my analysis.

The WTP estimate should also reflect the value of flood prevention of Filipino residents; hence, in theory it should be comparable to the cost incurred in building levees that prevent future floods. For example, the levee of the Iloilo Flood Control Program, initiated by the national government agency aimed to protect communities of urban Iloilo and adjacent towns (Ci:grasp, 2015).

Using the same analysis in Section 5.3.4, I also looked at the present value (PV) of this investment. First, I multiplied the WTP estimate with the total household population of the MI region to estimate the aggregate flood prevention expenditure (US$0.4M per year). As noted earlier, the sample is not representative of the population as a whole, so this estimate must be treated with extreme caution. Second, I calculated the PV of this expenditure using the same procedure as in Section 5.3.4. Findings suggest that it would only be possible to raise enough money to fund programs which cost less than US$5.4M. When I compare this *'value'* to the actual cost of the Iloilo Flood Control program (US$61M), the current expenditure on flood prevention appears more than adequate – perhaps even excessive.

That said, I found that WTP is positively related to actual flood damage, so if floods become more frequent and more severe in the years to come (as predicted), WTP will also increase – justifying increased expenditure on flood mitigation programs. Similarly, an increase in population would justify increased expenditure (with higher potential flood damage) and also increase the number of people from which to collect money to fund that expenditure.

Finally, it is worth reiterating the important point that WTP estimates may not be a *'true'* measure of the welfare cost of floods (for reasons discussed in chapter 2, and elaborated on in the conclusion). Using it to guide expenditure decisions may thus be unwise. Thus, it is also important to demonstrate a valuation technique that circumvents some of the problems associated with CV (specifically those that assume rationality and perfect information) – the LS approach (next chapter).

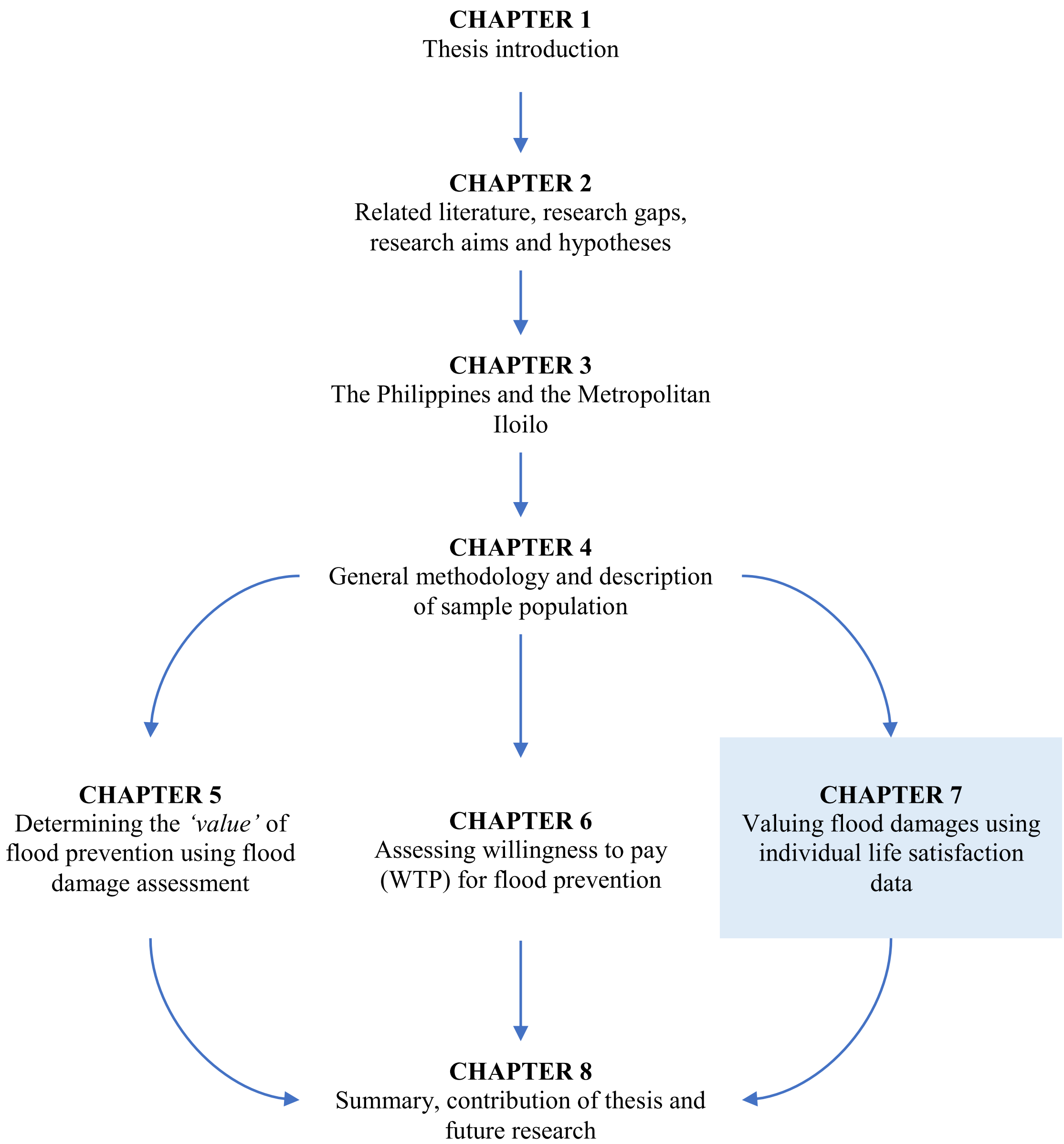
6.8. Chapter summary

The chapter investigated Filipino households' WTP to minimise mean flood damages. To do so, I had to design a flood valuation framework relevant to households in developing countries, to measure actual flood damages and to determine factors affecting household WTP. Using a carefully designed contingent valuation (CV) survey, I surveyed households in the Metropolitan-Iloilo (MI) region in the Philippines regarding recent flood damages (within the last five years) and asked about their WTP to prevent that type of damage in the future. I found that households were willing to pay around ₱108 or US$2.4 per year. Respondents' WTP was influenced by flood damage, education, income, attitudes towards flood experiences/risk and CV scenario and occupational multiplicity.

The results indicated two main points. First, household WTP is not only determined by (in)ability to pay, but also by a range of factors identified in earlier flood valuation and related studies such as years of education, number of adults in the household, respondent's attitudes towards flood risks, and effectiveness of flood prevention strategies. Less established in the literature is the negative link between occupational multiplicity in the household and WTP. Income diversification allows households to adapt to and minimise flood damages.

Second, residents of the MI region regarded flood as one of the major problems in their region, but the demand for structural preventive flood measures (e.g. levees) in the MI region is minimal - less than 2% of reported flood damage. This important issue is discussed in more detail in the concluding chapter of the thesis – but the significant differences could be, at least in part, due to some of the problems attending CV studies. As such, it is of interest to consider other valuation methods. The next chapter thus presents the results from the last economic method explored within this thesis, the LS approach.

Thesis outline



7: Valuing flood damages using individual life satisfaction data

Chapter outline

Research aims addressed in this chapter

General aim: Determine the impact of flood damages on LS, and the amount of income that would need to be paid to flood victims to *'compensate them'* (i.e. to hold LS constant) for the flood damage.

Specific aim #1: Understand the relationship between flood damage and overall LS to look at the determinants of LS by using self-reported monetary flood damages (as opposed to secondary flood data).

Specific aim #2: Explore the potential impact of relative flood damage – one's flood damage relative to others' flood damages in the community (next to absolute flood damage) on LS

- Estimate how much income would need to be paid to an individual to compensate them for flood, assuming that everyone in the community is affected; and

- Estimate how much income would need to be paid to an individual to compensate them for flood, assuming they are the only person in the community who is affected.

7.1. Chapter introduction

The overall aim of the thesis is to examine how much should governments spend on flood prevention. In Chapter 2, I pointed out that the contingent valuation (CV) method may be used to infer *'value'* to various environmental goods (Lindsey et al., 1995; Carson et al., 2001) and potentially that of flood prevention (Shabman & Stephenson, 1996; Zhai & Ikeda, 2006). I administered a CV method acquiring WTP for preventing flood damages (Chapter 3) and I found that households were willing to pay, but that WTP (although comparable to other studies in the literature) was less than 2% of reported flood damages.

I also found that scepticism about flood mitigation programs, years of formal education, household income and multiplicity of household occupations all affect WTP. Evidently, low WTP can be at least partially attributable to strategic behaviour/hypothetical bias, inability to pay, and problems with the flood damage estimation (e.g. over estimation). But the CV method also relies on respondents being able to accurately predict their utility (with and without flood mitigation) and on their willingness to truthfully and rationally answer questions posed in the WTP hypothetical scenario. So the low reported values of WTP may also reflect methodological problems associated with the CV – specifically those relating to these assumptions about rationality and perfect information. This chapter presents a less-restrictive method, the LS approach.

7.2. Research gaps in the life satisfaction-disaster/flood literature

The life satisfaction (LS) approach has recently been gaining attention in the economics discipline (Chapter 2). The method not only allows economists to determine the key drivers of people's LS, but has also been used to monetise the value of specific policies, such as programs promoting environmental quality (Dolan & White, 2007; Ferreira & Moro, 2010).

The LS approach assumes that it is possible to measure utility directly, unlike the WTP method, which works with an indirect utility function. There are, however, several research gaps associated with the LS approach and floods:

1) Most previous studies that have used the LS approach to assess environmental values, have used region-wide variables as proxies for environmental quality/quantity (e.g. elevation), and compared that to individual data on LS.

In this situation, unobserved heterogeneity may occur: it is unlikely that all individuals within the region experience the exact same environmental effect (as demonstrated in Chapter 5, people living in the same community, are impacted differently by floods).

2) In discussing LS, one should also assess the impact caused to neighbours or other people. The concept of income relativity has been well studied, but to the best of my knowledge, no one has used relative environmental quality (i.e. relative flood damage) in the LS approach.

Given these omissions from previous studies, this chapter looks at self-reported flood damages that match the LS scores and estimates the *'value'* of flood prevention, using both absolute and relative flood damages. In doing so, it provides details on how one could use the LS approach to determine how much to *'compensate'* residents (i.e. to hold LS constant) for flood damage.

Although the main objective of the chapter is to look at the income compensation from floods, it also offers important insights into these relationships in the case of floods in the Philippines. This chapter seeks to determine if the following hypotheses hold true and what are the directions of these associations: (1) the level of life satisfaction is affected by the individual (absolute) and relative flood risks; (2) Socio demographic characteristics (both individual and household) influences life satisfaction; and (3) built capital (such as roads and other infrastructure) in the neighbourhood of respondents' affects their life satisfaction. It has been described and suggested in Section 2.4 that outcomes from previous studies are varied.

The next section (Section 7.3) describes life satisfaction. The following section (7.4) describes the variables used to populate the model while Section 7.4 describes the analysis. Sections 7.5 and 7.6 present the results and discuss the findings, respectively. A concluding section follows (Section 7.7).

7.3. Variables used

Informed by the literature my aim is determine whether flood exposure – both absolute and relative – has impacts on LS, whilst controlling for other factors that may affect individual LS levels. The empirical model is described as:

$$LS_i = \alpha + \beta_1 \, lnY_i \; + \beta_2 \, lnFD_i(absolute) + \beta_3 \, lnFD_i(relative) \; + \delta X_i + \; \varepsilon_i \; ;$$

Equation 9.

where,

LS is the life satisfaction score,

FD (flood damage) is expressed both in absolute and relative terms,

vector X_i contains other determinants of LS, and

ε_i is the error term.

Here, as in other similar studies, LS scores are considered to be a proxy for utility. As such, one can assess the *'value'* of flood prevention by looking at the effects of flood damage (in here, both in absolute and relative terms) on LS levels. In Section 2.4 of Chapter 2, I showed that the income needed to compensate for flood damage can be derived from Equation 9 as *'income compensation'*.

In Chapter 4, I described how I designed the questionnaire, discussing the literature on how to elicit individual LS, how to elicit information about flood exposure and what non-flood related determinants of LS exist that I need to control for. In this chapter I use mean, median and maximum monetary flood damage to measure flood impact. The set of control variables that I used in the analysis, their descriptive statistics and their expected impact on LS are discussed in Chapters 2 and 4 and presented in Table 7.1. Below I briefly justify their inclusion and describe how the variables were constructed.

Table 7.1: Descriptive statistics of independent variables and their expected impacts on life satisfaction.

Variable	Mean (Std. Dev.) / % of total sample	Expected sign
Life satisfaction scores	66.7 (18.6)	Dependent variable
Mean monetary flood damage	₱9,012 (27,082)	Negative (Smith, 1992; Tan, et al., 2004; Luechinger & Raschky, 2009)
Median monetary flood damage	₱6,445 (25,743)	
Maximum monetary flood damage	₱ 18,403 (49,575)	
Good road condition (Likert scale 1 *'strongly disagree'* … 5 *'strongly agree'*)	3.4 (1.6)	Positive (Mitchell & Kemp, 2000; Sirgy & Cornwall, 2002; Cramm, Møller, & Nieboer, 2012)
Good health (Likert scale 1 *'strongly disagree'* … 5 *'strongly agree'*)	3.2 (1.1)	Positive (Idler & Benyamanini, 1997; Wen, Browning, & Cagney, 2003; Helliwell & Putnam, 2004; MacKerron & Mourato, 2009)
Committed to faith (Likert scale 1 *'strongly disagree'* … 5 *'strongly agree'*)	3.8 (0.6)	Positive (Helliwell, 2003; Helliwell & Putnam, 2004; Kahneman & Krueger, 2006; Sandvmica, Addai, & Takyi, 2012)
Individualised gross annual income	₱44,336 or US$985.24 per year (176,928)	Positive (Diener, Oishi, & Lucas, 2003; Luttmer, 2005; Altindag & Xu, 2008; Asadullah & Chaudhury, 2012; Castilla, 2012; Ha & Kim, 2013)
Employment status	Unemployed – 19% Securely employed – 23% Insecurely employed – 13% Retired and/or domestic worker – 46%	Positive (Clark & Oswald, 1994; Di Tella et al., 2003; Helliwell, 2003; Sarracino, 2013)
Adults	3.2 (2.0)	Household size is: Negative (Avramov, 2002; Terano & Mohamed, 2014) Positive (Cuñado & de Gracia, 2013)

Variable	Mean (Std. Dev.) / % of total sample	Expected sign
Children	0.8 (0.45)	Negative (Di Tella et al., 2001; Blanchflower & Oswald, 2004; Clark & Lelkes, 2006)
Age	47 (15.5)	U-shape (Blanchflower & Oswald, 2004; Helliwell & Putnam, 2004; Kahneman & Krueger, 2006) Young people happier (MacKerron & Mourato, 2009; Terano & Mohamed, 2014)
Years of education (in years)	9.8 (3.1)	Positive (Blanchflower & Oswald, 2004; Ferrer-i-Carbonell & Frijters, 2004)
Gender	Female – 69% Male – 31%	Female less happy (Sarracino, 2013) Not significant (Louis & Zhao, 2002; Kahneman & Krueger, 2006; MacKerron & Mourato, 2009; Cramm et al., 2012) Weak link between gender and life satisfaction (Helliwell & Putnam, 2004)

Previous researchers have demonstrated that income is a robust predictor of LS, where higher income is positively associated with LS at a diminishing rate (Easterlin, 1995; Helliwell & Putnam, 2004).[24] Respondents were thus asked to report gross household income and these responses were adjusted to include food grown at home and converted to individualised income (described further in Section 7.3.1.3.)

Research also shows that individuals who are unemployed tend to be less happy than others (Clark & Oswald, 1994; Di Tella et al., 2001; Helliwell, 2003). In this analysis, I use a variable derived from information about employment (unemployed, employed and retired / domestic worker) and employment security (unemployed, insecurely

[24] For a detailed investigation of the income-life satisfaction nexus, see Clark, Frijters and Shield (2008). I dropped social capital variables (see Chapter 4), namely the availability and reliability of family and friends and participation in community-related activities, because of a lack of variability in the answers provided by respondents.

employed, securely employed, retired / domestic worker). The derivation of these variables is discussed in Chapter 4.

Some studies have shown that having fewer children makes people happier, but some studies report insignificant effects of the number of children on LS (Di Tella et al., 2001; Blanchflower & Oswald, 2004; Clark & Lelkes, 2006). Some research has shown a negative link between household size and LS (Avramov, 2002; Terano & Mohamed, 2014); some has shown a positive link (Cuñado & de Gracia, 2013). In this analysis, I used the reported number of children (16 years old and below) and the number of adults in the household – and, based on the literature, have no prior expectations about the sign or significance of the variable.

Education is positively correlated with LS and the effect is higher for less-developed countries (Blanchflower & Oswald, 2004; Ferrer-i-Carbonell & Frijters, 2004). I used the number of years in formal education as a proxy for education.

The well-accepted link between age and LS is U-shaped (Blanchflower & Oswald, 2004). I included age (in years) and age squared to capture the expected non-linear relationship between age and LS.

Previous studies have demonstrated that the availability and accessibility of public infrastructure, such as roads (Mitchell & Kemp, 2000; Sirgy & Cornwall, 2002), having good health (Helliwell & Putnam, 2004; MacKerron & Mourato, 2009; Cramm et al., 2012) and strong religious beliefs (Helliwell, 2003; Pokimica et al., 2012) are positively associated with higher levels of LS (as religious beliefs and church attendance can raise social capital - Helliwell & Putnam, 2004). Moreover, it seems that subjective health assessments are valid and robust predictors of LS and may even be stronger predictors than objective measures, such as mortality and physical disability (Idler & Benyamanini, 1997; Wen, Browning, & Cagney, 2003).[25] Thus, to capture these important domains, I included a question in the survey that asked respondents to rate – using a five point Likert scale – their (dis)agreement with the following statements:

"Roads in my neighbourhood are bad and unreliable." [26]

"I am in good health."

"I am committed to my faith."

Finally, Sarracino (2013) showed that women are less happy than men, whilst others reported weak or no significant effect of gender on LS (Louis & Zhao, 2002; MacKerron & Mourato, 2009). Helliwell & Putnam (2004) noted that although men are generally happier than women, the relationship between gender and LS is not forthright. I included gender in my analysis – here too, having no prior expectations about its sign or significance.[27]

As previously discussed in Chapters 4 and 5, respondents were also asked to list all flood events they had experienced since June 2008 (i.e. the last five years from date of interview) and whether these flood(s) were experienced in their current location. The

[25] I did not control for personality and other personal characteristics because I did not collect those data. Optimistic respondents are more likely to give a higher rating to or positive assessments of their health status and their life satisfaction (Okun & George, 1984; Helliwell, 2003).
[26] Community-level data (e.g. population density) may influence individual life satisfaction through liveability (Sirgy & Cornwall, 2002) which is not controlled for in the regressions.
[27] Self-reported life satisfaction depends on traits, such as personality (Diener et al., 2003) and optimism (Tan et al., 2004), which were also not controlled for in the regressions.

reported flood damages were calculated in monetary terms and included various types of damages, such as property and loss of employment opportunities due to flood.

Dusenberry (1949) hypothesised that individuals would have lower well-being if their income was less than others and that this *'relative'* effect was stronger than the absolute. It provides at least one possible explanation for the empirical findings of Easterlin (1974) on the diminishing marginal utility of income. It also links to Pinker's (1997)[28] work, which highlights the fact that an individual's happiness/utility may be linked to the happiness/utility of others (in this case, with flood exposure of their neighbours). Subsequent empirical work by Easterlin (1995), Gokdemir and Dumludag (2012) and Ebrahim, Botha and Snowball (2013) has demonstrated the importance of relative income [perceived income compared to various reference groups (e.g. other races)]. I thus include measure of the relative impact of flood – to be discussed in Section 7.3.1.3).

7.3.1.1. Income

The analysis of willingness to pay (WTP) in the previous chapter (Chapter 6) looked at WTP per household, so I used information about household income. Since this chapter examines self-reported satisfaction, I had to use income at an individual level. Data from the questionnaire related to household income, and thus needed to be adjusted before use. Details of how that was done are given below.

7.3.1.2. Allowing for food grown at home

First, I acquired several pieces of information from the Family, Income and Expenditure Survey (FIES) (PSA, 2013) in the Philippines on the annual average

[28] as cited in Wilkinson and Klaes (2012)

household food expenditure (noted as $\bar{E}^{food}$). Next, I calculated the average household share of home-grown food in total consumption (noted as $\bar{s}$) – this is simply the average of all responses regarding the percentage of food grown at home. I then calculated the value of all food consumed in the average household (noted as $\bar{V}^{food\ cons}$) with the formula:

$$\bar{V}^{food\ cons} = \frac{\bar{E}^{food}}{1-\bar{s}}.$$

Next, I estimated the value of all home produced food in the household (noted as $V_{hh}^{home\ grown}$), with formula:

$$V_{hh}^{home\ grown} = s_{hh} * \bar{V}^{food\ cons}$$

From there, I calculated total household income that is adjusted for food production at home (noted as Y_{adj}^{hh}), with formula:

$$Y_{adj}^{hh} = Y_{rep}^{hh} + V_{hh}^{home\ grown}.$$

Where Y_{rep}^{hh} is reported household income. The variable Y_{adj}^{hh}, corresponds to the adjusted value of income that I will use to generate the individualised income, which is discussed next.

7.3.1.3. Individualised income

Larger households need more income than smaller ones, however, there are economies of scale to having additional members in the house with respect to income required (OECD, 2015). Since my LS analysis requires individualised income data, simply dividing reported household income by the household size would not capture the effects of economies of scale. Therefore I used a household size equivalent factor ($\sqrt{\#_{\text{adults}} + 0.7 \cdot \#_{\text{children}}}$) developed by Organisation for Economic Co-operation and Development (OECD, 2015) and Australian Bureau of Statistics (ABS, 2015) when converting household income data into individual income data (see Joung et al., 1997; Siermann, van Teeffelen, & Urlings, 2004; Arifwidodo & Perera, 2011 for some applications). It is this estimate of individualised income, which is subsequently inputted in the LS model.

7.3.1.4. Construction of variables capturing absolute and relative flood damages

First, I recoded the data in a manner that allowed me to assess individual flood damages relative to damages incurred by others in each respondent's community. This implies that I concentrated the analysis on respondents who lived in their current community for at least five years (n=524). Table 7.2 shows an artificial example of these calculations. The first two columns show that six respondents (1-6) were living in two different communities. The first three lived in community 1; the other three lived in community 2.

Focusing on community 1, I noted that residents 1 and 2 reported three flood events, whilst the third resident reported two events (see columns three to five). I set the number of flood events in the community equal to the highest number of floods reported by any one resident of that community, which in this case were residents 1 and 2, who each reported three flood events. The number of flood events in community 1 was, therefore, equal to three (column six). I then assumed that any resident of community 1, who reported less than three flood events, was not impacted (hence there were no monetary damages from houses and other properties, etc.) by the unreported flood event(s). Consequently, I impute a zero in the third damage column for resident 3 in community 1, as he/she only reported two flood events, whilst the community experienced three events (columns seven to nine show the revised data).

Table 7.2: Artificial data example of the construction of absolute and relative median monetary flood damages.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Resident	Community	***Reported*** monetary damage from flood(s)			# of floods in community	***Revised*** monetary damage from flood(s):			Individual monetary damage from flood(s)	Community monetary damage from flood(s)	Relative monetary damage from flood(s)
		#1	#2	#3		#1	#2	#3			
1	1	40	25	30	3	40	25	30	30.0	18.3	11.7
2	1	10	40	10	3	10	40	10	10.0	18.3	-8.3
3	1	15	25	-	3	15	25	***0***	15.0	18.3	-3.3
4	2	30	40	-	2	30	40	-	35.0	21.7	13.3
5	2	40	-	-	2	40	***0***	-	20.0	21.7	-1.7
6	2	20	-	-	2	20	***0***	-	10.0	21.7	-11.7

Subsequently, I calculated the individual median monetary damage for each respondent as the median of the revised monetary damage; for example, for respondent 3 that is median of 15, 25 and 0 is 15 (see column ten). Then I calculated the community's monetary damage as the mean of the median monetary damage for all respondents in a community; for example, for community 1, the mean of the median monetary damage is the mean of 30, 10 and 15, which is 18.3 (column eleven). Finally, relative median monetary damage was calculated as the difference between columns ten and eleven, reported in column twelve.

I also calculated maximum and mean flood damage (absolute and relative). The distribution of total monetary estimates was highly skewed (see previous discussion in

Chapters 4 and 5); therefore, looking for similarities and differences across measures of monetary damages were entered in logarithmic forms.

7.4. Analysis

As shown earlier, individualised income was converted to natural logs before estimating the LS equation, thus ensuring that the model was equipped to capture diminishing returns of income to LS. I analysed the set of flood factors known to influence LS (discussed in 0 of Chapter 2 and also in 4.2 of Chapter 4) including flood damages (Chapter 5). Using the Ordinary Least Square (OLS) method, a technique most common in LS studies (Ferrer-i-Carbonell & Frijters, 2004; MacKerron, 2012), these association were explored. Other types of regressions used in LS studies are: (1) ordered probit/logit for ordinal LS comparability (MacKerron & Mourato, 2009; Gong, Cassels, & Keegan, 2011; Sarracino, 2013); and (2) probit-adapted OLS (van Praag & Ferrer-i-Carbonell, 2008; Luechinger & Raschky, 2009). However, the outcomes of models that assume cardinality and those that do not are *'extremely similar'* (Ferrer-i-Carbonell & Frijters, 2004).

I estimated three regressions where Model 1 (median flood damages) was the baseline model that included the determinants of LS mentioned in Table 7.1. [29] Models 2 and 3 are presented as robustness checks. Model 2 (maximum flood damages) and Model 3 (mean flood damages) regressed all explanatory variables included in Model 1, but used maximum and mean flood damage, respectively, instead of median flood damage.

[29] Since Age squared is computed from Age, I expected a high variance inflation factor (VIF). This was not the case, so I opted to include both, as they are usually included in most life satisfaction investigations.

7.5. Results

Table 7.3 presents the findings from the three models. The adjusted R^2 for all models equalled 0.088. Compared to most studies that acquired data from LS databases, the regression has lower explanatory power: OLS adjusted $R^2 = 0.17$ to 0.20 (Sarracino, 2013); OLS – adjusted $R^2 = 0.25$ (Brereton et al., 2008). Similar explanatory power, however, was observed in regional/household level surveys of Arifwidodo and Perera (2011) (OLS – adjusted $R^2 = 0.08$) Andersson et al. (2014) (OLS – adjusted $R^2 = 0.036$) and Sekulova and van den Bergh (2013) (OLS – adjusted $R^2 = 0.091$).

Table 7.3: Ordinary Least Square (OLS) regressions describing life satisfaction.

Dependent variable: life satisfaction scores (0-100)	**(1) Median flood damages**	**(2) Maximum flood damages**	**(3) Mean flood damages**
Determinants of life satisfaction			
LN flood damage (absolute)	-0.574*	-0.611**	-0.672**
LN monetary flood damage (relative)	-0.634**	-0.583	-0.633
Good road condition	1.665***	1.640***	1.654***
Good health condition	-1.426	-1.444	-1.486
Committed to faith	-1.837	-1.918	-1.957
LN Income	2.926***	2.901***	2.905***
Unemployed	*reference*	*reference*	*reference*
Securely employed	-2.510	-2.559	-2.516
Insecurely employed	-0.849	-0.889	-0.848
Retired and/or domestic worker	-3.382	-3.445	-3.380
Number of adults in the household	0.056	0.061	0.057
Number of children in household	-5.541***	-5.513***	-5.494***
Age	0.169	0.175	0.182
Age squared	0.000	0.000	0.000
Year of education	0.457	0.457	0.469
Male	*reference*	*reference*	*reference*
Female	1.406	1.384	1.327
Constant	35.711***	35.926***	35.526***
Adjusted R^2	0.088	0.088	0.088
AIC	3494.602	3494.602	3494.380
Log-likelihood	-1731.272	-1731.301	-1731.190
Sample size (N)	407	407	407
MRS (all residents affected)	-0.196	-0.201	-0.231
MRS (only one resident is affected)	-0.413	-	-

Scatter diagrams of WTP determinants and Breusch-Pagan Test (χ^2 prob. = 0.0339) suggest presence of heteroscedasticity in the LS model. To control for heteroscedasticity, I chose STATA's OLS with robust standard errors option.

Findings from all models showed that LS was influenced by flood damage (absolute value), road condition, income and number of children. It was noted that the magnitude of coefficients for flood damage were slightly different across the three models, but directions of association were similar. That is, the coefficient of LN monetary flood damage (median) was -0.574 compared to -0.611 for LN monetary flood damage (maximum) and -0.672 for LN monetary flood damage (mean). For other significant variables, namely road condition, income and number of children, coefficients from the robustness check models were similar. I also ran various specifications of the explanatory variables (not shown here), such as using education dummies and household size instead of number of adults in the households. The resulting estimates from these regressions were quite similar to the ones presented. Therefore, the coefficients of these significant variables were robust across different estimates of flood damage; while relative flood damage was significant in Model 1, but not in others.

All significant variables had expected signs, but several socio-demographic variables were insignificant, specifically those associated with age (both age and age squared to capture the possible U-shaped relationship between LS and age; number of adults in the household, gender, education and employment). Their lack of significance contrasts with findings from other studies.

In farming communities in Malaysia (Terano & Mohamed, 2014) and in urban London (MacKerron & Mourato, 2009) young people were happier; while, Cramm et al., (2012) found that age was not a significant predictor of LS in small communities. In addition, smaller households were happier in the United Kingdom (UK) (Avramov,

2002) and in farm households in Malaysia (Terano & Mohamed, 2014). In the regressions, having children matters, but the number of adults in the household was insignificant. This is in contrast to the case of Spanish households, where more people in the house contribute to happiness (Cuñado & de Gracia, 2013). Previous researchers had found the effect of education to be small (Helliwell, 2003) or insignificant (Flouri, 2004; MacKerron & Mourato, 2009; Cramm et al., 2012) because of beneficial/positive effects of education through higher income and better health conditions (Helliwell & Putnam, 2004). Insignificance of unemployment is reasonably unusual. In the literature, social capital can (partly) negate the negative impact of unemployment on well-being, depending on the extent to which a person can substitute other activities for work (Dolan, Peasgood, & White, 2008). Thus, social capital may play a role in minimising the effects of being unemployed. Unfortunately, I am not able to test this since the lack of variability in the social capital variables included in the survey stops me from including them in the regression.

When asked to rate the level of importance of various factors to their overall life satisfaction, FGD participants reported that employment highly. However, with the regression results, only income is significant (Section 4.2.1). The relatively large and statistically significant coefficient on income accords with expectation and the findings of other researchers. Individualised income has been demonstrated to have a positive relationship with LS in less-developed areas: for Mexico (Castilla, 2012), Bangladesh (Asadullah & Chaudhury, 2012) and small and poor neighbourhoods in Cape Township (Cramm et al. 2012); hence, I expected a strong effect of income on

LS in poorer regions (Diener et al., 2003; Blanchflower & Oswald, 2004; Ferrer-i-Carbonell & Frijters, 2004; Luttmer, 2005; Ha & Kim, 2013).

The regression coefficients for absolute monetary flood damages were negative and statistically significant. Such results show that financial damage as a result of floods adversely affect individual well-being, which is in line with Smith (1992) and Luechinger and Raschky (2009). This evidence is also consistent with the literature showing that extreme natural calamities affect LS through causing mental disorders (McMillen, North, & Mosley, 2002; Tan et al., 2004). The negative coefficients for relative exposure imply that individuals are happier when their own absolute flood damage is smaller than that of their neighbours.

7.6. Income compensation for flood damage

Life satisfaction studies generally use estimates of the marginal rate of substitution (MRS), between income and environmental conditions, to estimate the marginal *'value'* of a change in the environment (formally, it was the change in income that would have had an equivalent impact on utility).[30] This is the amount of income that would need to be paid, to *'compensate'* someone for the damage incurred in a flood event (whereby the *'compensation'* ensures the LS does not fall).

Following suit, I used coefficients from Model 1 to generate two different monetary estimates for flood to estimate the compensating variation (or the MRS) for flood damage: (1) assuming that all residents are impacted equally (i.e. relative flood damage is zero) using the coefficient of the absolute median monetary flood damage and income; (2) assuming that only one individual is affected by flood; not the rest of

[30] For example: Luechinger & Raschky, 2009; Cuñado & de Gracia, 2013; Ambrey & Fleming, 2014; Andersson et al., 2014.

the community equally (i.e. relative flood damage is non-zero) using the coefficients of both the absolute and relative flood damage and income. The MRS estimates (when all residents are impacted equally) for Models 2 and 3 were not calculated because the relative flood damages were not significant in these models.

The first estimate derived from Model 1 [31] used absolute monetary flood damage and assumed that all residents are impacted equally; so relative flood damage was set to zero. The coefficients of LN income and LN median monetary damage were 2.926 and -0.574, respectively; giving a MRS estimate of -0.196. This means that income would need to rise by approximately 20% of the total monetary damage incurred from flood events, for the past five years, to enjoy the same level of LS. Converting these to monetary estimates[32]: the results suggest that for every ₱1,000 increase in flood damages across the five-year period, residents would need to be compensated by approximately ₱196 (US$4.36) each year for the five-year period (₱196 x 5 = ₱980). In short, the results suggest that if all people in the community were equally impacted by flood, then each individual would need to be close to fully compensated for the financial damages incurred, to maintain LS.

[31] Calculations are shown in Appendix M.

[32] Using the average household size (5.1 members per household) and average number of flood events per household (1.14 floods for five years) from the sample used

Table 7.4: Predicted 'compensation' required for flood damage using the life satisfaction approach, n=407.

Estimates	(1) Median flood damages	(2) Maximum flood damages	(3) Mean flood damages
a) MRS (all residents affected) in absolute value	0.196	0.201	0.231
b) Annual household flood damage, in ₱	1,515	4,196	2,055
c) Predicted annual compensation for flood damage if all residents impacted equally, per resident, in ₱, (a * b)	297	843	475
d) Predicted annual compensation for flood prevention if spending for flood prevention per household, in ₱, (c*5.1)	1,515	Not estimated †	Not estimated †

† Since the coefficient on relative damage was not significant.

The second MRS was only derived from Model 1, where I used absolute and relative flood damage, i.e. assuming that one individual was affected by flood, but no one else in the neighbourhood was. The second MRS estimate was equal to -0.413, which was derived by first adding the coefficients of absolute and relative flood (-1.21) and dividing that sum by the coefficient of LN income (2.926). Consequently, the MRS estimate of a resident who was the sole victim of the flood in the community is twice as high as the MRS estimate of a resident whose flood damage is similar to others in the community. Again, converting this to monetary estimates of *'compensation'* we find these to be much higher than in the situation where all people are affected equally [i.e. ₱413 (US$9) per year for every ₱1,000 (US$22) increase of flood damages over five years]. This result is consistent with findings from other researchers (Clark et al., 2008; Gokdemir & Dumludag, 2012) who find that it is not only income that contributes to LS, but income *relative to others*. It also makes intuitive sense, suggesting that if only floods affect one person, compensation needs to be higher because of the feeling of being singled out as the only person who suffered from flood.

Unfortunately, there are no studies on LS and flood to benchmark my estimates of relative flood damage, but I am able to comment on the first set of estimates. The study of Luechinger and Raschky (2009) used national-level flood data across countries and found that 23% of annual income is required to compensate for flood. This is remarkably close to my estimates, where it is assumed that all people are impacted equally. Although not directly comparable, one can find other studies looking at other types of disasters, for example, drought and terrorism. Quarterly droughts may reduce household income by US$18,000 annually in Australia (Carroll et al., 2009). Similarly, in studies on reduction of terrorism, the Irish were willing to pay as much as 41% of their income (Frey, Luechinger, & Stutzer, 2010), while residents of Paris were willing to pay around 14% (Frey & Stutzer, 2005).

My results thus seem *'plausible'*, although it is important to note that – like the other estimates presented in this thesis – they should not be treated as definitive and authoritative for several reasons. In particular, and as noted earlier, the LS approach relies on survey data, so estimates are only as reliable as the information provided by respondents – survey response bias and social desirability bias may be skewing results. The estimates may also be affected by endogeneity. There is much evidence from the literature about the difficulty of estimating marginal utility of income and thus, the MRS – since endogeneity is often present. For instance, income is oftentimes not instrumented (Oswald & Powdthavee, 2008; Fujiwara & Campbell, 2011), consequently producing a lower income coefficient in the regression. The key problem, however, is that formal tests for endogeneity rely on one's ability to firstly identify an instrument (as discussed in Chapter 6), and then use that instrument within the test. But instrumenting income is notoriously difficult. There are very few studies, which used instrumented income: Luttmer (2005), who instrumented income using predicted household earnings; Ferreira and Moro (2010) used social classes to instrument income; Dolan and Metcalfe (2008) used *'whether or not your partner is in employment and whether or not you are in rented accommodation'*; and Oswald and Powdthavee (2008) used *'lagged income,' 'dummy variable for observation of the paycheck,'* and *'lagged regional house prices.'* That said, Luttmer's (2005) and Pischke's (2011) found that estimates were different with and without instrumentation, but these differences were not substantial.

7.7. Chapter summary

This chapter adopted a different approach in capturing flood prevention demand. I used the LS or self-reported subjective well-being (SWB) method to determine the relationship between flood damages and LS in regional Philippines. Life satisfaction here is assessed, not only as a function of socio-demographic factors, but also of social determinants (e.g. good road condition). Unlike most LS studies that used secondary environmental data (e.g. national/regional level flood and emission data), I used self-reported flood damage, which has direct links to individual well-being.

The chapter confirmed some well-established contributors to individual LS relevant to less-developed countries, including road infrastructure, health, income and children in the household. More importantly, the results from the household survey showed evidence of a negative association between absolute flood damages and LS. One of the more significant findings to emerge from this study was that relative flood damage matters. The impact of relative flood damage, however, was less clear-cut than the impact of absolute flood damage on individual well-being. In addition, *'income compensation'* for flood damages was greater if only one household in the community was impacted by the flooding, compared to a situation in which all households in the community were affected equally.

Policies to minimise damages from flood and related natural disasters exist in the Philippines. For instance, the Office of Civil Defence (OCD), an organisation that runs the NDCC programs, initiated the Disaster Information for Nationwide Awareness Project (Project DINA) to disseminate information about public awareness on various disasters, including flooding (OCD, 2015). At the municipal level, the City Government of Iloilo implemented the Comprehensive Land Use Plan and Zoning Ordinance of Iloilo and completed the Jaro Floodway Project in 2011 (Iloilo City Government, 2012). This was in line with the findings in urban Jakarta, where community adaptability was also enhanced by residents' participation in communal cleaning of rivers, construction of drainage and building communal levees around their neighbourhood (Marfai et al., 2015). The findings of this chapter, if proven to be robust, may provide information for policy makers relating to flood damage prevention / mitigation policies.

The findings may also be relevant to policies relating to equity. Areas for improvement, as well as priority areas, must be identified at regional level and regional roles and policies should be coordinated. Results for relative flood exposure suggest that it is worth spending money on flood mitigation policies, but if the government implements mitigation policies, which protect some but not all residents, it is likely to worsen social divisions. Since rivers and typhoons do not have administrative divisions, flood policies should be regional and should be integrate with other development policies (e.g. poverty reduction). Sharing of resources is encouraged between municipalities as well.

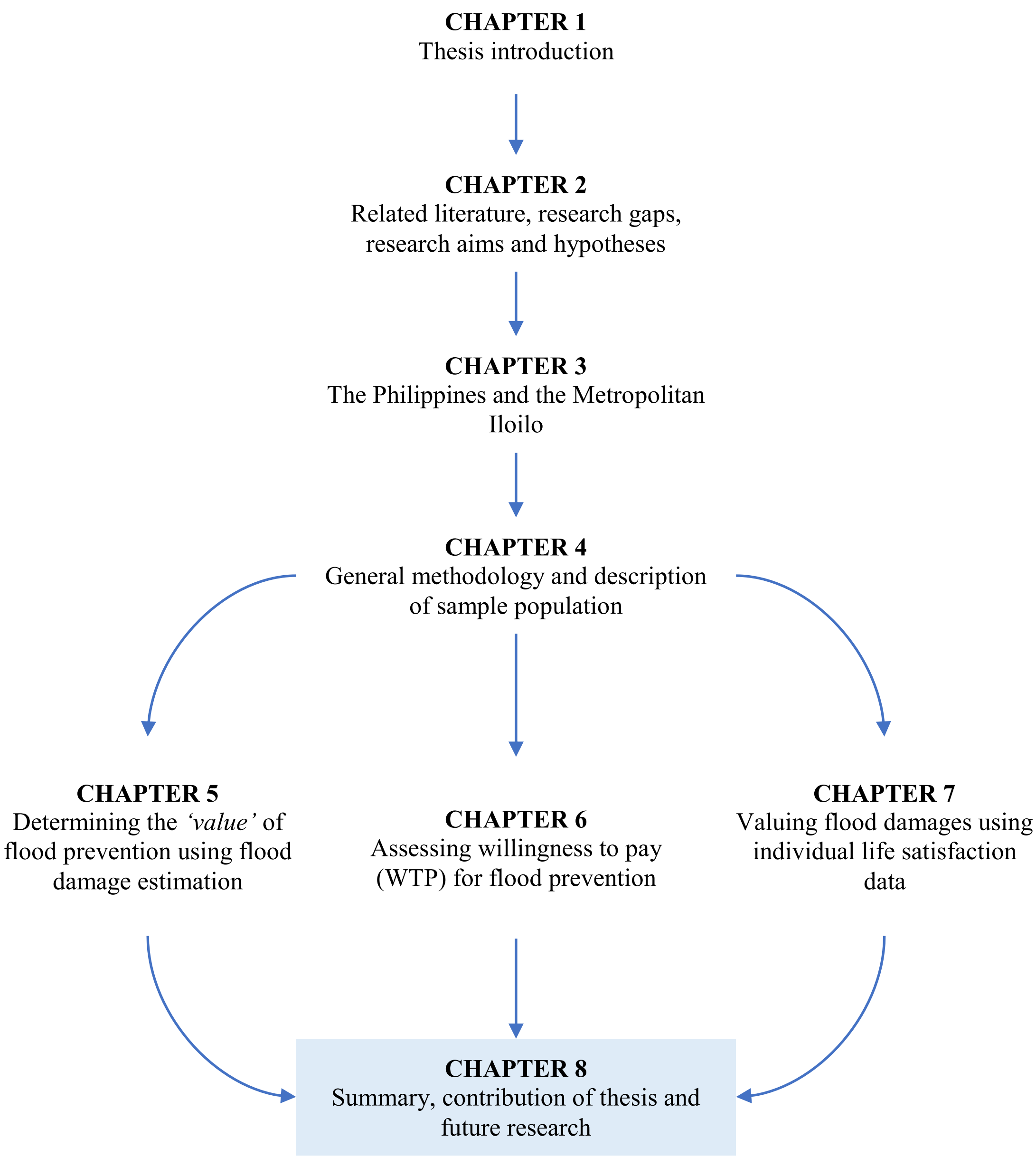
Whether these results hold true for other regional areas remains to be tested. Future research could examine factors, such as community livability (Sirgy & Cornwall, 2002) and social relationships that are known to influence key drivers of LS (e.g. income; Helliwell & Putnam, 2004).

Whilst exploring the impact of relative flood damage on individual well-being, I assumed that respondents compared their flood exposure to the impacts of others in their community, i.e. fellow community members were the assumed reference group. It is also important, however, to test the validity of that assumption by using other reference groups that may exist (e.g. flood exposure in neighbouring communities) (Gokdemir & Dumludag, 2012; Ebrahim et al, 2013).

Finally, the examination of reverse causation in future research is also worth noting, as individuals with high reported well-being may have moved to less-flood prone or flood-free communities.

In conclusion, it seems that the LS approach has its inherent problems, as do the flood estimation and the CV methods. Therefore, the core question is *which of the three* *suffers from the least problems?* I formulate an answer to this query and conclude my thesis in the next chapter.

Thesis outline



8: Summary, contribution of thesis and future research

Chapter outline

8.1. Thesis background

8.1.1. Research problem and summary of thesis aims

In Chapters 1 and 2, I presented various narratives of how individuals and communities have been affected by progressively heavier rains, stronger typhoons and floods (Wisner et al., 2004; Julca, 2012). Flooding is both an economic and social problem, as it affects people and the environment. Thus, preventing or mitigating the impact of floods is important to the well-being of communities.

Flood prevention is a public good, where non-rivalry and non-exclusivity are present. With public goods, provision is not profitable, so there is no incentive for the private sector to provide. The flood prevention market is also hampered by imperfect information, therefore, the government has a role to play in redressing market failure, a key policy question being: *'how much should be spent in preventing flood damages?'*

Recognising the difficulty of assessing both flood damages and the welfare impact of flood damages, I choose to consider the question from three perspectives, specifically,

1) Determine how much damage to households could be avoided if one were able to prevent flood (flood damage assessment);

2) Determine how much households are willing to pay to avoid future flood damages (contingent valuation or CV method); and

3) Determine the impact of flood damages on LS, and the amount of income that would need to be paid to flood victims to '*compensate*' them (i.e. to hold LS constant) for the flood damage (life satisfaction or LS method).

8.1.2. Summary of data collection and methods of analysis

I chose the Philippines as the case study region, primarily because it is one of the most vulnerable countries in the world in terms of disasters; it experiences around 20 typhoons a year and is predicted to experience more with climate change (IPCC, 2014; UNU-EHS, 2014). In most less-developed regions such as in the Philippines, investments to minimise flood impacts are usually limited or of low priority (Benson, 2009) and data on flood damages and their impacts on individuals and households are inadequate or unavailable (Iloilo City Government, 2012). For instance, in Benson's (2009) review of disaster-risk management in the Philippines, she described local government initiatives to be limited and inconsistent with the national mandate of mainstreaming disaster programs. In weighing costs and benefits of flood prevention projects, local and regional policy makers need information on how much floods affect people's well-being.

My focus was on the Metropolitan Iloilo (MI) region in the Philippines for four main reasons. First, there is much intraregional variation in flood exposure, in terms of distance to/from rivers and creeks in the area. Second, recent evidence (Benson, 2009; Iloilo City Government, 2010; Lasco & Delfino, 2010) suggested that floods have been one of the major problems in the region and regional/local economies have been impacted regularly. Third, the MI area has a diverse economy providing an opportunity to collect data from a wide variety of different households (of different socio-economic status and dependent upon different industries) for comparison in my analysis. And lastly, there is anecdotal evidence that flood or disaster related programs have been mismanaged in the region.

The data collection process occurred between December 2012 and July 2013. Surveys relating to these methods must be planned and executed carefully, because for instance, residents may report inaccurate responses (Krumpal, 2013). First, I conducted a systematic literature review to familiarise myself with standard techniques for assessing the (market) value of flood damages (Section 2.2) and to determine factors that may affect WTP (Section 2.3) and LS (Section 2.4).

Next, I ran six focus group discussions in the case study region to identify regionally relevant factors influencing WTP and LS and to prepare a survey questionnaire for the pre-test survey that followed (Section 4.2.1). In the pre-test survey, I also established an effective data collection method (i.e. face-to-face interview rather than drop-off and collect method) and assessed the reliability of the hypothetical scenario used in the CV part of the study (e.g. set of prices for the payment card, frequency of payments and payment vehicle) (Section 4.2.2). Lessons learned from the FGDs and pre-test survey were used to finalise the questionnaire for use in the main survey. The questionnaire was translated into the local dialect (using the back translation method) (Section 4.3.1). Enumerators underwent survey training prior to the survey execution. A total of 600 respondents were personally interviewed from June to July 2013 (Section 4.3.2). In Section 4.3.3, I discussed the multi-stage sampling that was initiated in all six towns and one city of the MI region. A combination of geographical and purposive sampling was used.

8.2. Key findings

Key findings and synthesis from each chapter are shown in Table 8.1 and are discussed in this section and in Section 8.3.

Table 8.1: Summary of results from damage assessment, CV and LS methods in estimating flood prevention.

	Chapter 5 - Damage cost assessment (n=524)	**Chapter 6 -** CV Method (WTP to avoid future damages, n=387)	**Chapter 7 -** LS method (Impact of flood on LS and associated monetary *'compensation'*, n=402)
Component of values captured	Mainly monetary flood damages but there was an attempt to measure intangible flood damages (through self-reported safety level threats during floods)	Both monetary and non-monetary flood damages	Both monetary and non-monetary flood damages
Empirical findings	Households incurred flood damages of around ₱1,800 to ₱3,700 per year (US$39 to US$82) Compared to related studies, my flood damage estimate is low. Mean safety threat scores were low while the average depth of water inside houses reported was approximately 57cm.	Households are willing to pay about ₱108 per year (US$2.4) to avoid all future flood damage. For this sample, the WTP is only 1.26% of (estimated) mean flood damage.	For this sample, households would need to be compensated by on average, approximately ₱1,515 (US$34), to keep LS constant when impacted by floods. The estimates were close to the mean flood damages reported.
Key constraints / limitations	The monetary estimates excluded intangibles (which suggests they underestimate *'true'* welfare impacts), but they also neglect people's ability to undertake personal flood mitigation activities (suggesting they may overestimate *'true'* welfare impacts). The net impact of both biases is indeterminant.	Although, the WTP captures intangible costs, the CV method has many constraints: survey-related/hypothetical biases, including bounded rationality; rationality/ market related assumption (i.e. it assumes that individuals are able to successfully predict their utility in the current and *'hypothetical'* scenario); and WTP is a function of ability to pay.	The method captures intangible costs but is prone to social desirability bias and context effects. While getting around most of the problems of the CV method, the endogeneity of income is a potential problem. If income is endogenous, it affects the calculation of income *'compensation.'*
Data challenges	Safety threat level data were unable to yield significant, and perhaps valid responses	Other important variables, were not included because of highly skewed responses, such as social capital (e.g. relationships with neighbours), private mitigation activities, and self-reported assessment of	Other important variables, were not included because of highly skewed responses, such as religion, social capital (e.g. relationships with neighbours), house tenure, distance to rivers/forests, etc. There have also been a

	Chapter 5 - Damage cost assessment (n=524)	**Chapter 6 -** CV Method (WTP to avoid future damages, n=387)	**Chapter 7 -** LS method (Impact of flood on LS and associated monetary *'compensation'*, n=402)
		prevention/mitigation activities in their respective communities.	difficulty of finding an instrumental variable for income in this study.
Methodological findings / contributions	This chapter offers some insights into the long-term effects of (recurring) floods (i.e. within a five-year period). This particular focus allows examination of heterogeneous impacts across households (even within the same community).	The preparation and execution of the CV survey were designed to control for scepticism and hypothetical bias (by asking flood impact questions first). I formulated a flood valuation framework that shows interrelationships between factors affecting WTP, and allowed for those interrelationships when estimating the empirical model. Scepticism related among others to individual's scepticism about the level of flood risk and the success of the flood prevention scheme and was found to have a statistically significant (positive) relationship with WTP. However, scepticism alone, does not explain why WTP is only a small fraction of actual damages reported. Other limitations such as (im)perfect information and the rationality assumption were not controlled in this study.	This work on the use of the LS approach on flood prevention enhances our understanding of determinants of LS in a developing (and flood prone) country setting. I allowed for subsistence farming, by calculating household income using reported household income, including the value of food grown at home, and controlling for economies of scale using household information (e.g. number of adults and children). To the best of my knowledge this is the first time that has been done in an LS study. Variables relating to employment were also used by combining reported rating on how secure respondents rate their employment and by their actual employment status (e.g. employed, unemployed, etc.). The LS model used relative monetary flood damage (finding evidence that it is not only the damage incurred by an individual that affects LS, but also damage compared to others in the community). To the best of my knowledge, this has never been done before.
Future research	Further work is required to capture all components of flood damages, and subsequently determine the overall cost for flood prevention.	Several questions remained unanswered at present. One relates to relativity (of flood risk) and its possible inclusion in the WTP	Further studies with more focus on endogeneity in LS estimation are therefore suggested. Moreover, various ways of

	Chapter 5 - Damage cost assessment (n=524)	**Chapter 6 -** CV Method (WTP to avoid future damages, n=387)	**Chapter 7 -** LS method (Impact of flood on LS and associated monetary *'compensation'*, n=402)
	As discussed in Chapter 2, depreciation must be considered in assessment as well as the indirect and/or intangible impacts. Also, exploring and comparing various discount rates, private mitigation activities, and/or extreme flood events are also worth investigating.	model. Application of other statistical analyses that control for interrelationships is also worthwhile. Another is to investigate private mitigation activities and determine who will it affect the WTP responses.	measuring relative flood risk are also recommended.

8.2.1. Flood damage assessment

As mentioned in Sections 2.1 and 2.2, assessments of flood damages are complex as damages may be direct or indirect and tangible or intangible. Prior studies that have estimated flood damages noted monetary impacts but little is known in terms of non-monetary impacts, especially in economics. In addition, very little is understood about the long-lasting impacts of floods as most studies looked at single events. Household-level assessments were also limited, especially for government-led assessments. Therefore, the first focal question for this study was to determine how to estimate flood damages at the household level over a span of five years (in this case, between 2008 and 2013), rather than estimating damages from a single extreme event (which will, of course, inflate *'average'* damages if extreme events do not occur annually). I explored various measures of flood damages such as frequency of floodings, flood water depth inside houses, self-reported safety threat scores and monetary flood damages (personal/property damages, employment losses and other damages).

I found that households experienced on average about one flood in the five year period; although no floods were reported in the communities of Binangkilan in Sta. Barbara and of Sta. Monica in Oton.

With respect to safety threat scores (Likert scale 1 to 5, where 5 is '*most threatened*'), I found that reported mean scores were not skewed as opposed to other flood measures. Surprisingly, low threat scores were found and results seem to suggest that intangible impacts were low.

For each community, I compared the average (self-reported) estimates of flood water depth experienced by respondents, with data on the community's elevation.

Households in low-lying communities reported high flood water, suggesting that self-reported estimates are likely reliable (at least, on average). Further research could usefully test if models that use self-reported estimates of flood water depth are as reliable as those which use estimates of floodwater depth that have been inferred from elevation data.

I was also able to estimate the mean monetary flood damages incurred by households over a five-year period: ₱8,790 (≈US$200) on average per flood event. Damages to personal items and property comprised 65% of total damages. There was evidence to suggest that damages varied across households with different socio-demographic characteristics (e.g. household income, number of income sources and household size). For example, expressed as a percentage of income, mean flood damages were higher for households in the bottom two income deciles than they were for households in the upper two deciles. These preliminary findings were explored further using multivariate analysis, which is discussed in Section 8.2.2.

When compared to studies that looked at household flood damages in developing countries, such as Bangladesh (Brouwer et al. 2009) and Vietnam (Navrud et al., 2012; Bui & Nguyen, 2014), my estimate of household flood damage was low. This highlights the importance of research about flood damages over an extended period of time, rather than focusing only on the damages associated with extreme events. It is the *'average'* damage incurred over a period of time that best reflects the damages that could be avoided (and hence, the benefit) of flood mitigation activities.

As noted earlier however, this does not mean that the *'optimal'* level of expenditure on flood mitigation is equal to the damage avoided. First, as noted in Section 2.2 and shown in Table 8.1, I argued that respondents might have overestimated their reported damages in the survey (Farber et al., 2002; Krumpal, 2013). Second, this method may be biased because it assumes that households do not undertake private mitigation activities (e.g. moving away from flood-prone neighbourhood or elevating their houses). Evidence exists that households do employ substitution strategies such as flood mitigation strategies (Botzen et al., 2009). Property insurance that covers flood damage is also available in the Philippines (Jimeno, 2014) for households. Community-level structure programs, such as communal levees were implemented in urban environments because they are less costly and effective (Marfai et al., 2015).

Third, the estimated flood damages consisted of direct (e.g. property damages) and indirect (e.g. employment losses during flooding periods) damages that can be monetised. It does not include intangible damages, which implies the damage estimate may be an underestimate. However, I collected data on intangible damages (e.g. self-reported safety threat experienced during floods) and found that they were present, but the estimates were small and insignificant to many respondents. Thus, when the government uses this estimate as a guide for the level of flood expenditure, it should be aware of these shortcomings.

8.2.2. The contingent valuation (CV) method

Prior studies have sought to generate a more appropriate estimate of the *'value'* of flood damage, including intangibles, and allowing for the fact that people are able to undertake actions that help mitigate damage themselves. A popular approach, is to estimate willingness to pay (WTP) using the contingent valuation (CV).

Like researchers before me, I hypothesised that household WTP is a function of various factors, which may include flood risk (flood damage per event and number of flood events), individual/household characteristics and perceptions/attitudes. But unlike many previous researchers, I also attempted to model some of the complex interrelationships between those factors. I designed a flood valuation framework (Section 2.3.1), which captured various relationships between factors. This approach is quite unique as none such studies have been conducted for the Philippines and studies that have been conducted elsewhere rarely capture these complex interrelationships. Preparation of the CV study involved a careful process and was discussed thoroughly in Chapter 4. In Chapter 6, I reported results from the CV study.

Sections 6.2 to 6.5 show the step-by-step approach in dealing with the complex interrelationship between flood risk, individual/household characteristics and perceptions/attitudes towards floods/flood risk and the hypothetical scenario. Using a two-stage interval regression, households were willing to pay around ₱108 (US$2.4) per year to prevent any future flooding.

Two of the most interesting findings were the effects of the level of scepticism towards flood/flood prevention and occupational multiplicity of households on WTP. These variables were not properly tested in most flood valuation studies and usually done after statistical regressions. Scepticism about floods/flood risks was highly significant, where high levels decreased WTP. When asked about perceptions regarding flood risk and other concerns (e.g. *'I am not prepared to pay anything to minimise flooding unless others pay too'* or *'I do not believe that the fund would produce the promised levee banks (the money might just be wasted*'), *'sceptic'* respondents would either disagree or give *'neutral'* responses. This observation is not surprising as scepticism to disaster programs exists in developing countries such as the Philippines, as a result of improper monitoring and management of some shelter projects that brought about mistrust of governments (Alcalde, 2015). Brouwer et al. (2009) found that Bangladeshis expected the government to provide flood mitigation projects; hence their WTP was zero or low. However, this should be interpreted carefully because even for the most sceptic respondent (i.e. having a scepticism score of 1), the increase in WTP was from ₱108 to ₱136, which is a change from US$2.34 to US$3.02 per year is still far below reported mean flood damage (around ₱2,800 per year) (using n=387).

In addition, households with diverse occupation sources have low WTP. The observed relationships could be attributed to the idea that capacities of households to minimise their flood impacts may depend on various sources of livelihoods at home and that WTP is highly dependent on people's perceptions towards the level of their flood risks and/or perceptions towards the flood prevention strategy.

The CV method is analysed through stated preferences by individuals, so is likely to be constrained by biases. In Chapter 2 and in Table 8.1, I discussed some limitations such as possible strategic bias (which included free-riding and expectation towards provision of flood prevention by the government). Strategic behaviour may bias WTP responses (Section 2.3) when respondents do not answer truthfully; for example, respondents may think their response will influence the flood prevention investment and therefore they under (over) state their damage (Whittington et al., 1990). Furthermore, WTP is a function of ability to pay, which implies that poor individuals/household who *'value'* flood prevention highly will nonetheless give low stated WTP. I controlled for some of these biases and its related discussion is in Section 8.3.

8.2.3. The life satisfaction (LS) approach

The use of life satisfaction (LS) data to value environmental attributes is relatively new in the academic literature, but as discussed in Chapter 2, its application in informing public choice shows potential. The third aim in this thesis was to determine the *'value'* of flood prevention using this approach. This study addressed a limitation of previous LS studies with regards to using environmental data sourced from various databases. This is problematic, as the data do not have direct links to LS data and therefore a scale mismatch arises. The present study was also designed to capture households' flood damages relative to their neighbours, based on reported household impacts, which has never been done in any disaster/flood disaster studies or even in general LS studies.

Good road condition, good health, income and fewer children were found to contribute to high life satisfaction. These results match those observed in earlier studies (Helliwell & Putnam, 2004; Terano & Mohamed, 2014; Castilla, 2015). The most important and relevant finding was that relative flood damages (i.e. calculated mean flood damages relative to the mean flood damage of households of the same community) affect LS negatively. This finding implies that individuals were happier when floods impacted them less, compared to others in similar circumstances.

The *'value'* of flood prevention can be derived from the LS model and is known as the *'income compensation'* required for changes in flood damages, with constant life satisfaction level). In Section 7.6, I showed that at a household level, approximately ₱1,515 (US$34) should be given to households per year, in order to compensate for flood damages.

Arguably, applying the LS approach in an empirical setting faces fewer challenges than applying the CV. By this, I mean that most biases associated with the CV are not found in LS surveys. However, at least two challenges remain. First, relates to the question of whether LS data are a good measure of utility (Dolan & White, 2007; Kristoffersen, 2010; Fujiwara & Campbell, 2011). Three difficulties identified and discussed by Fujiwara and Campbell are: (1) remembering past experiences; (2) context effects; and (3) reporting life satisfaction. Still, there is evidence that life satisfaction responses are valid and good measures of well-being (Krueger & Schkade, 1993; Frey, Luechinger, & Stutzer, 2010; Fujiwara & Campbell, 2011; Stutzer & Frey, 2010), which I discussed thoroughly in Section 2.4. Second, is the fact that income may not be exogenous in LS models. If income is endogenously determined (e.g. income is a function of life satisfaction or work to generate income may reduce life satisfaction), the coefficient on income in the regression analysis will be biased. Since, one uses the income coefficient to calculate *'income compensation'* endogeneity will affect final estimates. Some LS studies – using instrumental variables – show that income is indeed endogenous in LS models and that controlling for endogeneity changes income coefficients (Dolan & Metcalfe, 2008; Oswald & Powdthavee, 2008). However, these researchers treat their own findings with caution given the weakness of the instruments. This highlights the key problem: finding appropriate instruments. Ferreira and Moro (2010) instrumented income using six social class categories and found that coefficients of various types of environmental variables are large and robust across specifications.

8.3. Synthesis

Fujiwara & Campbell (2011) showed that *'income compensation'* estimated from a LS model should – in theory – be identical to WTP. However, in this thesis, I found that *'income compensation'* was (1) considerably higher than WTP and (2) almost similar to the mean flood damage.

If WTP is the *'true'* value of flood prevention, then this suggests that

a) There are significant problems with the LS approach (most likely attributable to endogeneity, since other problems relate to survey implementation, which would, arguably, also affect CV estimates).

AND

b) The flood damage assessment method grossly overestimates welfare gains from flood prevention. If flood damages overestimate welfare costs, then the cost of intangibles must be small relative to the *'benefits'* of being able to engage in private prevention/mitigation activities is large. Alternative, flood damages may have been grossly overstated by respondents.

The potential significance of endogeneity has already been addressed above. As regards (b) first, there is evidence in the literature that intangible impacts such as PTSD are significant and have long-lasting effects on individuals (Smith et al., 2011; Crabtree, 2013). Most of my respondents reported low threat scores, but there were still many who reported high levels of threat.

Furthermore, it is unlikely that residents in developing countries – of whom the majority are rather poor – have the ability to engage in significant private prevention/mitigation activities. In Sagrada in the Philippines, wealthy landowners elevated fishpond walls while poor fishermen households were financially constrained to do similar mitigation activity (Gaillard et al, 2008). In addition, Zoleta-Nantes (2002) documented that urban poor households (including *'street'* children) in Manila mitigate their flood losses through *'narrower'* strategies, such as strengthening their house posts and rummaging wood planks/stones/hollow blocks for makeshift bridges. When asked about their flood mitigation strategies, both the wealthy and poor households did not indicate the purchase of insurance. Consequently, while some mitigation strategies may exist (which may explain why WTP is below mean flood damage), their magnitude seems limited.

Therefore, I consider it unlikely that negligible intangibles and substantial opportunities for private flood mitigation activities can alone explain the substantial gap between WTP and mean flood damage. Whilst it is possible that flood damage estimates were grossly overstated by respondents, the fact that damage estimates were – as expected given the five-year focus – much lower than estimates from other researchers (Section 6.7.3), leads one to ask if estimates from the LS and flood damage models might be better approximations of real welfare costs than those from the CV model; at least in this instance.

My WTP estimate is consistent with those found in other relevant flood valuation studies. This led me to suspect that the problem of low WTP is embedded in its assumptions (not in the implementation). Two of the method's core assumptions, which I was unable to control for relate to rationality and perfect information. The CV will not be able to estimate *'true'* welfare costs, if respondents are unable to correctly assess flood risk or to their course of action when faced with flood risk (and hence their utility, and WTP for changes in utility under different scenarios).

Floods are low-probabilistic events, whose probable occurrence, people are known to underrate or misjudge (Viscusi & Zeckhauser, 2006). Botzen and van den Bergh (2012) explored assessment of flood risk and WTP for flood insurance and found that *"homeowners neglect the low probability of flooding"* (p. 152). Schumacher (2015) found that beliefs (optimistic and pessimistic) affect people's utility and therefore, their assessment of expected utility. This suggests that optimistic Filipinos may likely assess their flood risk very low. It can be thus suggested that when using the CV method to explain *'values'* for flood, it should be used with caution, unless one is better able to assess the extent of *'inability to predict utility'* problem. In my case, respondents may have indicated low WTP because they do not understand the benefits of the flood programs and/or they do not know the risks associated with flood.

Even if respondents accurately assessed their flood risk, they may not take the *'rational'* course of action. Traditional and cultural (disaster) mitigation activities are dominant in the Philippines (Gaillard, Liamzon, & Maceda, 2005) and may have affected WTP responses. Bankoff (2004) studied culture of disasters in the Philippines and found that disasters are seen as a *'game of chance'* and are often expressed as *'bahala na'* or *'leaving it to fate.'* This means that few households (27%) engaged in mitigation activities, because *'praying and doing good deeds'* would help them with their flood problems. Gaillard et al. (2008) also documented flood mitigation activities in the Sagrada, Philippines and found that 70% of individuals indicated that *'pray more often'* was one of their strategies to adapt to frequent floods. Similar beliefs were found in poor households Bangladesh (Brouwer et al., 2009).

My LS estimate is close to the mean monetary flood damage estimate, which is correct if the effects of mitigation and intangible damage are similar (i.e. cancel each other out) or small. The estimates from my LS model may closely approximate *'true'* welfare measures if endogeneity is not present (or if its affects are small). I was unable to find a suitable instrument, so did not test whether income in my model is exogenously determined. Some studies have found that instrumented income variables have (slightly) higher coefficients (Luttmer, 2005; Oswald & Powdthavee, 2008) and as a consequence, the required *'income compensation'* calculated from models which control for endogeneity is lower than that the compensation associated with models that do not. This suggest my *'income compensation'* (slightly) overestimates the *'true'* value of flood prevention, which is then below the mean monetary damage estimate.

In conclusion, the difficult to explain gap between WTP and the estimate resulting from the flood damage assessment method combined with – relative to the LS method – long list of biases that plague the WTP method, lead me to put more faith in the estimate arising from the LS method.

8.4. Future research

Understanding the other biases relating to all these methods and their (potential) effects to the *'value'* of flood prevention are important issues for future research. I summarise them into three broad research areas below.

First, further research on the role of relativity would be worthwhile. The relative effect of income (which has been studied in the LS literature) is important, but my thesis showed that relative flood damages are also significant. This is particularly important as I found that flood impacts have skewed distributions and they are heterogeneous [i.e. impacts on households in the same community (or impacts on communities in the same region) are different]. Therefore, more research in this area would inform policy makers how to better consider equity/distributional issues. At the moment, most policy makers are guided by the cost-benefit analysis (CBA), which focuses on efficiency rather than equity.

In future investigations of WTP, it might also be possible to include relative flood damage in the analysis. Botzen et al. (2013) made a similar investigation asking people to rate their level of flood risk relative to others. However, this aspect is not well-studied using the CV method and may constitute a new avenue of research within the CV method.

Second, I have shown in this thesis that interrelationships between determinants of WTP for flood prevention were significant; but (possible) interrelationships should be tested with other statistical tools. One could consider, for example, the structural equations model (SEM), which captures these complex relationships. This is also applicable to LS studies, where one could potentially use similar tools (e.g. SEM) and control for the endogeneity of income (although there is still the core problem of finding an appropriate IV for income) and other relationships (e.g. correlation between flood damages and household characteristics).

Lastly, more comparitive research is needed to test which of the three methods (and potentially other methods) is *'better'* at estimating *'value'* for flood prevention, which given the problems that surround these methods may come down to establishing which method is least inaccurate.

Since my results showed a huge discrepancy between WTP on the one side and LS and damage assessment on the other side; there still seem to be many problems with the CV method (and perhaps other non-market valuation techniques, for example, choice modelling) that need further refinement. Other studies have pointed at the importance of the quality of information in flood prevention/mitigation, which warrants further research comparing WTP scenarios *'with or without'* or *'good or bad'* information. In the non-market valuation literature, this area of investigation is not new (Bergstrom, Stoll, & Randall, 1990; Whitehead & Blomquist, 1991; Blomquist & Whitehead, 1998), but to the best of my knowledge, no research has been conducted in flood valuation studies where the problem of imperfect information (and thus, a likely inability to be able to accurately predict utility in current and hypothetical scenarios) is particularly problematic. Therefore, further studies should be done to investigate the impact of imperfect information and/or bounded rationality as well as strategic and hypothetical biases in applications of non-market valuation techniques to floods.

Earlier in this thesis, I recognised the role of *'third parties'* such as NGOs in administering programs for flood prevention. Thus, looking at the willingness to pay for flood prevention or willingness to contribute labour to a community-level flood prevention program [similar to Navrud et al. (2012)] may be relevant to other communities in the Philippines and may be worth further investigation.

The literature suggests that the general flood damage assessment method does not capture intangible impacts and private prevention/mitigation activities well. Since my results of the damage assessment method (no control for intangibles and prevention/mitigation) and the LS method (control for intangibles and prevention/mitigation) are close, the impact of intangibles and prevention/mitigation on the *'value'* of flood prevention is either small or equal (i.e. they neutralise each other). If indeed the effects of intangibles and prevention/mitigation on the *'value'* of flood prevention are small, then the damage assessment method is an attractive alternative to the LS method given its lower data gathering and computational costs. Further research in this area is warranted for example exploring better ways to measure intangible flood damages. Since there is evidence that non-monetary damage is an important part of flood impacts. The DEFRA survey about trauma of floods and the associated household damages shown as a good guide for local and national governments. More research is needed to understand the importance of intangible impacts in flood damage estimation as well as to determine how to properly incorporate these data into existing and future estimations.

8.5. Concluding comments

Flooding adversely impact well-being of people. Floods and their impacts are predicted to become worse in the future due to climate change and rapid economic growth. Governments in less-developed countries have limited funds and have struggled to find resources to prevent these impacts – this is particularly important in disaster vulnerable countries, such as the Philippines. Governments have crucial roles to play in preventing these impacts but they need (accurate) information about the required level of expenditure to manage their resources. In response to these imminent problems, the present study was designed to determine the *'value'* of flood prevention using three valuation techniques: flood damage assessment; contingent valuation (CV); and life satisfaction (LS) methods.

This study has found that generally, flood impacts are substantial both in monetary and intangible terms. The evidence suggests that investment in flood prevention is worth undertaking; however, more research is needed to improve these methods to increase their usefulness and practical application. One of the most significant findings to emerge from this study is the fact that the LS method seems to be a good approach in valuating floods. If the debate is to be moved forward, a better understanding of the limitations of the LS approach (particularly endogeneity of income) needs to be developed. In effect, this will allow policy makers to ground their decisions relating to floods in evidence – keeping in mind the ultimate goal of maintaining, or perhaps even improving the wellbeing (LS) of those who live within the communities they represent.

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Appendix

Appendix A: Natural hazards vulnerabilities in sampled barangays (communities).

Community	Flood, flash flood and landslide vulnerabilities	Rating
Sta. Barbara		
Agutayan	75% of *barangay* proper was affected by flood during Typhoon Frank. Flash flood of moderate turbidity occurs rarely. Flood depth of >1.0m occurs rarely	High impact, low to moderate flood frequency
Binangkilan	None in *barangay* proper. Flash flood occurs rarely and affects the rice fields only.	Low to moderate impact, low to moderate flood frequency
Buyo	High. Flash flood with low turbidity commonly occurs. Flood depth of >1.0m occurs seasonally.	High impact, frequent floodings
Duyanduyan	Flash flood with low turbidity and depth of >1.0m occurs rarely. 3 houses were totally damaged during Typhoon Frank.	Low to moderate impact, low to moderate flood frequency
Lanag	None in *barangay* proper. Flash flood with high turbidity and flood depth of >1.0m occurs rarely and affects areas near Tigum River.	Low to moderate impact, low to moderate flood frequency
Pal-agon	Flash flood with very high turbidity and flood depth of >1.0m occurs rarely (Typhoon Frank).	Low to moderate impact, low to moderate flood frequency
San Miguel		
Barangay 12	None	Low to moderate impact, low to moderate flood frequency
Igtambo	None in *barangay* proper only in areas near the banks of the Aganan River. Flash flood with low turbidity occurs rarely. Flood depth of >1.0m occurs rarely.	Low to moderate impact, low to moderate flood frequency
San Jose	None	Low to moderate impact, low to moderate flood frequency
Oton		
Botong	Flash flood occurs rarely only during typhoons with heavy and continuous rainfall. Areas near the banks of Botong Batuan Creek are prone to bank scouring/erosion and flash flood. Some portions of the *barangay* are located near the coast. These areas are prone to coastal flooding, storm surge, coastal erosion and liquefaction.	High impact, frequent floodings
Poblacion West	Flash flood occurs rarely only during typhoons with heavy and continuous rainfall and release of water from San Miguel Dam. Areas near the banks of Batiano River are prone to bank scouring/erosion and flash flood. Lack of drainage system.	Low to moderate impact, frequent floodings
San Antonio	Flash flood is common and occurs yearly during rainy season. Areas near the banks of Batiano and Iloilo River are prone to bank scouring/erosion and flash flood. Some portions of the *barangay* are located along the coast and are prone to coastal flooding, storm surge, coastal erosion and liquefaction.	High impact, frequent floodings
Sta. Clara	Flash flood occurs rarely only during typhoons with heavy and continuous rainfall. Areas near the banks of Sta. Clara Creek are prone to bank scouring/erosion and	Low to moderate impact, frequent floodings

Community	Flood, flash flood and landslide vulnerabilities	Rating
	flash flood.	
Sta. Monica	Flash flood occurs rarely only during typhoons with heavy and continuous rainfall. Areas near the banks of Anhawan Creek and irrigation canals are prone to bank scouring/erosion and flash flood.	Low to moderate impact, frequent floodings
Sta. Rita	Flash flood occurs rarely only during typhoons with heavy and continuous rainfall. Areas near the banks of Anhawan Creek and irrigation canals are prone to bank scouring/erosion and flash flood.	Low to moderate impact, frequent floodings
Leganes		
Buntatala	Flooding-seasonally high	High impact, frequent floodings
Cagamutan Norte	Flooding-seasonally moderate	Low to moderate impact, low to moderate flood frequency
Guinobatan	Flooding-seasonally high	High impact, frequent floodings
Lapayon	Flooding-seasonally low	Low to moderate impact, low to moderate flood frequency
Cabatuan		
Ayaman	-	-
Bacan	Flash flood with high turbidity is common. Riverbank scouring also affects the area.	High impact, frequent floodings
Baluyan	Flood susceptibility is high in areas near Tigbauan Creek during rainy season.	High impact, frequent floodings
Salacay	Bank scouring along Tigum river affecting portion of Zone 1 and 2. The *barangay* proper is less susceptible in flood. Flash flood is possible to occur in Tigum River.	Low to moderate impact, low to moderate flood frequency
Sulanga	-	-
Tabucan	Riverbank erosion along Tigum River was observed. Areas along the riverbanks of Zone 1 (10 houses) and 2 are affected with susceptibility to flooding during rainy season. Possible flash flooding also on Tigum River.	High impact, frequent floodings
Talangahuan	The *barangays* proper are seasonally flooded with depth of less than 0.5 meter. Sitios Kamunsilan and Hacienda are seasonally flooded with depth of more than 1 meter. Flash flood with high turbidity is common.	High impact, frequent floodings
Tiring	Purok 2 (Brgy. Proper) and Purok 3 are seasonally flooded with depth of more than 1 meter affecting agricultural areas. 3 houses located near Tigum riverbank may be affected by erosion.	High impact, frequent floodings
Pavia		
Aganan	Flash flood susceptibility is high. Areas near the banks of Aganan River are prone to bank scouring/erosion.	High impact, frequent floodings
Ungka I	Flash flood susceptibility is high. Areas near the banks of Aganan and Jaro Rivers are prone to bank scouring/erosion.	High impact, frequent floodings
Iloilo City		
Molo	Flash flood susceptibility is moderate. Areas near the	High impact, low to

Community	Flood, flash flood and landslide vulnerabilities	Rating
Boulevard	banks of Batiano River are prone to bank scouring/erosion.	moderate flood frequency
Bo.Obrero-Lapuz	Flash flood susceptibility is low.	Low to moderate impact, low to moderate flood frequency
Sto. Niño Sur	Flash flood susceptibility is low.	Low to moderate impact, low to moderate flood frequency
Tabuc Suba	Flash flood susceptibility is high. Areas near the banks of Jaro River are prone to bank scouring/erosion.	High impact, frequent floodings

Summarised from OCD - Western Visayas Regional Office reports (OCD, 2013, not dated).

Appendix B: International, national and local guidelines related to flood and other disasters.

International guidelines	Guidelines and its description
Hyogo Framework of Action (HAF)	The Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters (HFA) is *'the first plan to explain, describe and detail the work that is required from all different sectors and actors to reduce disaster losses'* (UNISDR, 2015). In January 2005, the Philippine government adapted the HAF, which sets guidelines regarding monitoring, review and reporting of progress of various disaster programs.
Sendai Framework for Disaster Risk Reduction	A post-HAF, the Sendai Framework (2015-2030), constitutes four areas of interest: (i) Understanding disaster risk; (ii) Strengthening disaster risk governance to manage disaster risk; (iii) Investing in disaster reduction for resilience and; (iv) Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction
Cluster Approach of the United Nations (UN)	The Cluster Approach of the United Nations is the current international humanitarian coordination system (UNOCHA, 2015). In 2007, the NDCC adopted the UN Cluster Approach. This approach identifies key sectors or areas of activities (e.g. food relief) and ensures mobilisation of resources between the agencies of the government and other organisations in time of disasters.
ASEAN Agreement on Disaster Management and Emergency Response (AADMER)	The AADMER is the 'first legally-binding HFA-related instrument in the world' (ASEAN, 2015)'. In 2009, the Philippine government ratified the AADMER, which aims to '*promote regional cooperation and collaboration in reducing disaster losses and intensifying joint emergency response to disasters in the region.'*
National level	**Guidelines and its description**
Presidential Decree 1566 (PD 1566 of 1978)	Strengthens the Philippine disaster control, capability and established the National Program on community disaster preparedness (created the NDCC), later called the National Disaster Risk Reduction and Management Council (NDRRMC).
Local Government Code (LGC of 1991)	The code provided local autonomy of the local government units (LGUs).
Republic Act 9729 (RA 9729 or the Climate Change Act of 2009)	This legislation provides legal framework for mainstreaming of climate change policy to government policies.
Republic Act 10121 (RA	This legislation institutionalises the disaster management

10121 or the Philippine Disaster Risk Reduction and Management Act of 2010)	programs at various levels.
Regional level	**Guidelines and its description**
Resolution No. 05 Series of 2012	Resolution approving and adopting the Regional Disaster Risk Reduction and Management Plan (RDRRMP) of Western Visayas
Town/City level	**Guidelines and its description**
Iloilo City	Comprehensive Land Use Planning (1998-2010) and the Comprehensive Land Use Planning (2011-2020) – Ordinances that serve as *'basis for strategically laying the foundation to the direction of the City's urban development.'* It includes Land Uses and Zoning Plan that considers *'disaster risk-reducing and climate change-resilient development strategies.'*
Leganes	Ordinance No. 287, Series of 2013 – An ordinance enacting the guideline on the implementation of pre-empted evacuation in response to man-made and natural disaster and for other purposes. Ordinance No. 337, Series of 2014 – An ordinance creating the Municipal Disaster Risk Reduction and Management Office (MDRRMO) of the municipality. Executive Order No. 11, Series of 2015 – An order reorganising the Municipal Disaster Risk Reduction and Management Council (MDRRMC).
Oton	Executive Order No. 12, Series of 2012 – An order reorganising and reinforcing the Municipal Disaster Risk Reduction and Management Council (MDRRMC) by organising the Municipal Disaster Risk Reduction Management Office/Committee of the municipality. Resolution No. 96, Series of 2012 – A resolution adopting the Municipal Disaster Risk Reduction and Management Manual. Executive Order No. 05, Series of 2013 – An order reorganising and reinforcing the Municipal Disaster Risk Reduction and Management Office (MDRRMO)/Committee of the Municipality of Oton and redesignating the Deputised Coordinator for the purpose. Ordinance No. 260, Series of 2014 – An ordinance creating the Municipal Risk Reduction and Management Office (MDRRMO) of the municipality.
Pavia	Municipal Ordinance No. 14, Series of 2011 – An ordinance creating the Municipal Risk Reduction and Management Office

	(MRRMO). Executive Order No. 6, Series of 2013 – An order reorganising the Municipal Disaster Risk Reduction and Management Council (MDRRMC) of the municipality.
San Miguel	Executive Order No. 27, Series of 2013 – Reorganising the Municipal Disaster Risk Reduction and Management Council (MDRRMC) of the municipality.
Sta. Barbara	Executive Order No. 13, Series of 2011 – An order re-organising and institutionalising the municipality emergency response unit to be referred as 'ALERTO Sta. Barbara'. Executive Order No. 13, Series of 2012 – An order strengthening the Local Disaster Risk Reduction and Management Council (LDRRMC) of the municipality. Executive Order No. 14, Series of 2012 – An order organising/strengthening of the Municipal Council for the Protection of Children (MCPC) incorporating the early childhood care and development coordinating committees. Executive Order No. 4, Series of 2013 – An order institutionalising the coordination mechanism among the disaster response units in the municipality. Executive Order No. 22, Series of 2013 – An order establishing the volunteer and citizenship desk and its focal person. Executive Order No. 24, Series of 2014 - An order further strengthening the Local Disaster Risk Reduction and Management Council (LDRRMC) of the municipality. Executive Order No. 32, Series of 2014 – An order designating the volunteer desk management officer in the municipality. Resolution No. 57, Series of 2014 – A resolution approving the proposed Local Disaster Risk Reduction and Management (LDRRM) Plan of the municipality.
Cabatuan	Executive Order No. 35, Series of 2013 – An order reorganising the Municipal Disaster Risk Reduction and Management Council (MDRRMC) and the Municipal Disaster Risk Reduction and Management Office (MDRRMO) in the municipality. Executive Order No. 10, Series of 2014 – An order organising the Cabatuan Emergency Response and Risk Reduction Team (CERRRT) in the municipality. Resolution No. 1, Series 2014 – A resolution approving and adopting the Municipal Disaster Risk Reduction and Management Plan (MDRRMP) in the municipality.

Summarised from various information from respective LGUs and related websites.

Appendix C: JCU Ethics Approval Form.

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Appendix D: Focus group discussion guide questions.

Document A: Focus Group Discussion (English Version)

Focus group discussion objectives

1. To identify the best word/phrase to describe 'overall satisfaction with life' in the MI area, Philippines;
2. To identify and discuss factors that contribute to overall satisfaction with life in the MI area, Philippines
3. To determine how to measure factors' presence/absence, quality/reliability and quantity/range of goods/services;
4. To identify relevant scenario for contingent valuation
5. Problems/threats to the natural environment in the MI area, Philippines
6. Impacts of these threats to individuals, households, communities etc.
7. Possible solutions for prevention of these problems/threats.

Focus group discussion materials
Focus group discussion guide (Document A)
Research brief (Attachment A)
JCU information sheets (Attachment B)
JCU informed consent forms for focus group discussion (FGD) (Attachment C)
Payment Card (Attachment D)
Envelop

Focus group discussion checklist
Audio recorder(s)
Spare batteries for the audio recorder(s)
Sign sheet
Paper pads, pencils and name tags (for each participant)
Pens and markers (for documentation)
Red dots – 60 pieces
Refreshments and souvenirs

Focus group discussion procedure

1. Give research brochure (Attachment A) to each participant.
2. Read aloud the research brochure and the FGD consent form (Attachment C) to the group.
3. Get each participant to sign the informed consent form.
4. Conduct focus group discussion.

Hello, my name is Cheryl and I am from Iloilo City, Philippines. I am currently postgraduate student at James Cook University (JCU) in Australia and a faculty member at the University of the Philippines (UP). This project is my doctoral research project and I will be spending the next two years working with urban and rural residents of the Metropolitan Iloilo (MI) area in the Philippines. The MI area consists of the city of Iloilo and the towns of Oton, Sta. Barbara, San Miguel, Leganes, Pavia, Jordan, Buenavista, Nueva Valencia, Sibunag and San Lorenzo.

My study aims to understand more about the natural environment and its contribution to the overall satisfaction with life. I have read many textbooks and articles about the topic but I have little idea on what makes the residents of the Metropolitan Iloilo (MI) area contented with their lives. My readings tells me that overall satisfaction with life depends on a lot of things, such as buildings, income (or money), people, quality of their natural environment and other factors, too (Show Figure 1)

(FIGURE 1: Overall satisfaction with life depends on various things)

Photographs:
Hospital
School/University
Car
Road
Money
Family
People having lunch/dinner together
Beach/Coast
Trees/Forest
Park
River
Mangroves
Airport
Banks/Non-formal financial institutions

This focus group discussion series is the first stage of my data collection, where there will be seven discussions with residents from all towns and city in the MI area. In June to August 2013, a survey will be conducted to around 1,200 residents of the MI area. A stakeholder workshop will also be conducted in January 2015, which will invite stakeholders that are involved in the development of the MI Area.

However, I cannot proceed with the survey without a questionnaire. This is the reason I am here today - I would like to ask for your help in developing my questionnaire. I believe that as residents of MI area, you are the best people to judge of what is important to your overall satisfaction with life and of your natural environment. I am doing this study to get a ‘balanced-way of understanding’ of what contributes to overall satisfaction with life. In the end, the study will provide useful information for government and non-government organisations, in understanding more about regional growth as well as about your society and environment.

I will be your facilitator for this discussion and I will be assisted by, Paul, my research assistant. The discussion will run for about one hour to one hour and a half and will be broken down into three sections. In our discussion, there might be some issues that are unclear and unresolved. To facilitate on-time and smooth discussion, I will be designating a ‘parking lot’, wherein we will list these issues. If we have enough time, we will go back and discuss them one by one. Remember, that there are no wrong answers as I am here to know your opinions.

I will be audio recording our discussion as I cannot remember everything. From time to time, you will also notice that I will be taking down some notes. Do not worry as all answers will be confidential and for my research project use only. It will not be shown to the public. I also ask that everyone here keeps what everyone says confidential. If there are some of the questions that I may be asking that may be difficult for you to talk about, feel free to skip them.

Do you have any questions before we proceed?

Focus group discussion questions

Description of happiness and overall satisfaction with life
I have used the term 'overall satisfaction with life', but it might not be the best way to describe human well-being. In my study, I am not interested on the word 'happiness', which is an emotion felt in a short period of time. I am particularly interested on the idea of what makes people satisfied with their lives for a long period of time.

I am currently living in Townsville, in tropical Australia and I am fairly satisfied with my life. In our community, we have a beautiful park beside a river, where you can have your daily morning/afternoon walk and tour weekend barbeque/family gathering. One of the biggest shopping mall, which includes grocery and retail stores, is only a block away from where I live, which makes my day to day transactions very easy. I also have a scholarship, so I study for free. Though I have constant communication with my family and my friends in the Philippines, I cannot physically share with them my leisure and day-to-day activities in Australia. These things make me fairly satisfied with my life in Australia.

I would like you to help me understand about 'overall satisfaction with life' by sharing what do you think about this term?

What do you think makes people contented or satisfied with their lives?

Which item(s) do you think that can go together?

Which item(s) driving your overall satisfaction now and in the future?

Which phrase or word would you recommend to use in my study – for example, 'quality of life', 'overall satisfaction with life' or 'life contentment? '

Discussion about the factors that may influence overall satisfaction with life
The second part of our discussion is about the things and issues that may influence overall satisfaction with life. According to the textbooks I have read, it depends on many things (SHOW Figure 1) such as infrastructure or buildings in your community, as well as banks or other non-formal sources of income.

First, are there any big groups, which are missing in the illustration (Figure 1)?

The next part of the discussion is looking at each of these factors in details.

How might you understand the following words, (1) presence/absence, (2) quality/reliability (3) quantity/range of goods/services and (4) future?

Given our understanding of the terms, how might you measure each of the factor's presence/absence, quality/reliability, quantity/range of goods/services and future?

Can you discuss your answers?

I will give ten (10) red dots, wherein they represent level of importance.

I want you to allocate your dots to the list of factors we have mentioned earlier (show the list of factors they have listed earlier).

For example, you out two red dots in factor 1 (randomly select on item on the list) and all the remaining dots (i.e. 8 red dots) to factor 2 (randomly select on item on the list). This implies that factor 2 is more important than factor 1.

Thirty-minute break.

The natural environment in the MI area, Philippines

Aside from basic infrastructure/buildings, finance and people, overall satisfaction with life also depends on the natural environment. When I say 'natural environment', I mean the natural resources, such as plants and animals. I would like to hear your thoughts about the natural environment. Particularly about different ways that could reduce or prevent destruction of the natural environment

What problems and/or threats, relating to the natural environment, are happening in the MI area?

What do you think are the things that could be done, in order to prevent or minimise these problems and/or threats?

In my questionnaire, there will be a question about people's willingness to pay for improving/preventing the natural environment. (Show sample Attachment D: Payment card)

In this case, what will be the best price range (in Philippine peso, ₱)?

What is the appropriate/acceptable collection method(s) to be used?

What institutions can be trusted to manage these funds?

How often do you think they should collect the funds?

I appreciate your time spent here today. We are at the end of our discussion. If you have anything to add, you may free to do so.

Appendix E: Research Brief (Attachment A of FGD).

Research project background

Hello, my name is Cheryl and I am from Iloilo City, Philippines. I am currently postgraduate student at James Cook University (JCU) in Australia and a faculty member at the University of the Philippines *(UP). This project is my doctoral research project and I will be spending the next two years working with urban and rural residents of the Metropolitan Iloilo (MI) area in the Philippines. The MI area consists of the city of Iloilo and the towns of Oton, Sta. Barbara, San Miguel, Leganes, Pavia, Jordan, Buenavista, Nueva Valencia, Sibunag and San Lorenzo.*

My study aims to understand more about the natural environment and its contribution to the overall satisfaction with life. I have read many textbooks and articles about the topic but I have little idea on what makes the residents of the Metropolitan Iloilo (MI) area contented with their lives. My readings tells me that overall satisfaction with life depends on a lot of things, such as buildings, income (or money), people, quality of their natural environment and other factors, too (Show Figure 1)

What is the purpose of this focus group discussion?

This focus group discussion series is the first stage of my data collection, where there will be seven discussions with residents from all towns and city in the MI area. In June to August 2013, a survey will be conducted to around 1,200 residents of the MI area. A stakeholder workshop will also be conducted in January 2015, which will invite stakeholders that are involved in the development of the MI Area.

However, I cannot proceed with the survey without a questionnaire. This is the reason I am here today - I would like ask for your help in developing my questionnaire. I believe that as residents of MI area, you are the best people to judge of what is important to your overall satisfaction with life and of your natural environment. I am doing this study to get a 'balanced-way of understanding' of what contributes to overall satisfaction with life. In the end, the study will provide useful information for government and non-government organisations, in understanding more about regional growth as well as about your society and environment.

I will be your facilitator for this discussion and I will be assisted by, Paul, my research assistant. The discussion will run for about one hour to one hour and a half and will be broken down into three sections. In our discussion, there might be some issues that are unclear and unresolved. To facilitate on-time and smooth discussion, I will be designating a 'parking lot', wherein we will list these issues. If we have enough time, we will go back and discuss them one by one. Remember, that there are no wrong answers as I am here to know your opinions.

I will be audio recording our discussion as I cannot remember everything. From time to time, you will also notice that I will be taking down some notes. Do not worry as all answers will be confidential and for my research project use only. It will not be shown to the public. I also ask that everyone here keeps what everyone says confidential. If there are some of the questions that I may be asking that may be difficult for you to talk about, feel free to skip them.

Do you have any questions before we proceed?

Appendix F: Informed consent form (Attachment C of FGD).

I understand the aim of this research study is to understand the contribution of natural capital to human well-being of the Metropolitan Iloilo (MI) area in the Philippines. I consent to participate in this project, the details of which have been explained to me and I have been provided with a written information sheet to keep.

I understand that my participation will involve a focus group discussion and I agree that the researcher may use the results as described in the information sheet.

I acknowledge that:

- ☐ taking part in this study is voluntary and I am aware that I can stop taking part in it at any time without explanation or prejudice and to withdraw any unprocessed data I have provided;

- ☐ that any information I give will be kept strictly confidential and that no names will be used to identify me with this study without my approval;

(Please tick to indicate consent)

I consent to participate in a focus group

- ☐ Yes
- ☐ No

Name: (printed)	
Signature:	Date:

Appendix G: Copyright form for photos used.

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for privacy reasons

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for privacy reasons

Appendix H: Main survey questionnaire (English translation).

1) Identification number: [ ] [ ] [ ] [ ]

2) Town location
   - ☐ Iloilo City
   - ☐ Leganes
   - ☐ Oton
   - ☐ Pavia
   - ☐ San Miguel
   - ☐ Santa Barbara
   - ☐ Cabatuan

3) Barangay/community location: ________________

4) Enumerator code: [ ]

5) House location - latitude/longitude: ______/______
   Nearest riverbank location - latitude/longitude: ______/______
   House elevation (from the street/ground): ______

6) Interview date: ___/___/ 2013 Time started: ______ Time finished: ______

7) Did the interviewee complete the survey?
   ☐ Yes ☐ No (indicate the number of the last question answered: Q# ___)
   List all unanswered (or refused to answer) questions: ______________________________

Checked by the field supervisor - Signature: _______________ Date ___/___/ 2013

Section 1: About rivers and forests in your neighbourhood

The first section asks about your household's flooding experience. Flooding is the overflowing of water from a nearby river/stream that may cause inundation of areas not normally submerged by the water. Please tick ☑ one box that is applicable to you and/or answer the following questions.

8) How far away is the nearest river? _____ kilometres (km)

9) How far away is the nearest forest? _____ kilometres (km)

10) In what month and year did you start residing at your current address? _____/_____
    If applicable, where did you live before (barangay/community)? ___________

11) Have you *ever* experienced flooding?
    ☐ Yes ☐ No
    If NO; *please go to Question #18*

12) Note the extent of flooding and list the **non-financial** loss(es) (psychological effects) from each flooding event **in the last 5 years** as well as the **financial** loss(es) to your household (in terms of damage to personal property, loss of employment opportunities and other expenses e.g. transportation, medicine, drinking water, etc.). Take note that flooding damages are from flood waters (discard any other damage you may have incurred from the flooding event(s), like wind damage).

Approximate time of flood (month, year)	**Were you living here at the time?**	**How deep was the flood water in the street outside your house/home/apartment block (in centimetres, cm)**	**Was your life or safety threatened and/or that of your family or close relative or friend?** Not threatened				Very threatened	**Damage to personal properties, land and/or crops (₱)**	**Loss of employment opportunities and/or opportunities to grow/catch food (₱)**	**Additional expenses (₱)**
			1	**2**	**3**	**4**	**5**			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			
	☐ Yes ☐ No		☐	☐	☐	☐	☐			

13) Are there any other inconveniences that you and your household incurred from the above mentioned floods?
☐ Yes ☐ No
If YES, please elaborate:
____

14) Which of the flooding events (if any) listed in Question #12 do you consider to be the worst of all? ______________

15) When was the worst flooding that your household *ever* experienced and where did you live at that time?
- ☐ Same as above
- ☐ Not same as above - When (month and year): ____________ Where (barangay/community): ___________

16) Have you taken any steps in minimising your future flood losses at your current address?
☐ Yes ☐ No; **If YES**, what did you do? ___________________________________

17) Have you or would you ever consider moving away from where you live now <u>because of flooding</u>?

1	2	3	4	5
No – have never considered				Yes – think about it often

If answer is either 1 or 2, why not?

- ☐ Flooding is not a problem here.
- ☐ I am not financially able to.
- ☐ I have employment commitments that prevent me from leaving.
- ☐ I cannot leave as my close family and/or friends live nearby.
- ☐ Others, please specify: ___________________________

Section 2: *Your perceptions about finance, building, people, community and others*

18) How do you rate the flood disaster assistance in your community or town?

Effectiveness of flood disaster management in your community	**Effectiveness** Not effective → Very effective					
	1	**2**	**3**	**4**	**5**	**NA**
Pre-disaster *(preventive and preparedness measures - e.g. warning signals)*	☐	☐	☐	☐	☐	☐
During flood *(disaster relief, response actions, etc. – e.g. relief good, rescue)*	☐	☐	☐	☐	☐	☐
Post-disaster *(rehabilitation, reconstruction, etc. – e.g. rehabilitation centre)*	☐	☐	☐	☐	☐	☐

Section 3: *Overall satisfaction with life*

19) On a scale from 0 to 100, how do you rate your life satisfaction? (0 is the lowest and 100 is the highest score): ______

0	10	20	30	40	50	60	70	80	90	100
Not satisfied										Very satisfied

Section 4: *Flooding in the Metro-Iloilo Guimaras (MIG) area, Philippines*

The Metro-Iloilo Guimaras (MIG) area covers all of the Guimaras Province and part of the Iloilo Province. The area is part of the Greater Negros-Panay Rainforest ecoregion, which is home to most diverse flora and fauna in the Philippines. The MIG area's economy is growing rapidly - most residents work in the agriculture and fisheries industries; whereas residents in Iloilo City and Oton are mostly employed in commercial industries, particularly in retail.

The region faces many problems and threats. Some of these are beyond our control (e.g. earthquakes and typhoons), but not all. One of the major problems is FLOODING, which is an overflowing of water from a nearby river/stream that may cause inundation of areas not normally submerged by the water.

Earlier, you listed the damages your household incurred (or not incurred) as a result of flooding in the last five years.(interviewer: direct the respondent to the table they filled out under Q12 to quickly review that damage). You also stated that your overall life satisfaction is (Direct the interviewer to <u>Question #20 and read out his/her answer</u>). _____. (0 is the lowest and 100 is the highest score)

What would your overall 'life satisfaction' score be if it were possible to prevent that type of flooding (and associated damage) from ever occurring again in your neighbourhood? __________

Suppose it was possible to prevent all future flood damage by, for example, building levees banks, etc. The only problem of course, is that it would cost money to do that. Suppose that a fund is set up to raise money for those levee banks and your household was asked to donate to this fund through a collection administered by barangays/communities What is the maximum amount (in ₱), you would be willing to donate each and every year to a fund that builds and maintains those levee banks, thus preventing you from ever experiencing flood damage again? ____________ (money donated)

₱ 0 ☐	₱ 2 ☐	₱ 3 ☐	₱ 5 ☐	₱ 10 ☐	₱ 15 ☐	₱ 20 ☐	₱ 30 ☐	₱ 50 ☐	₱ 100 ☐	₱ 200 ☐	₱ 500 ☐	₱ 1000 ☐	More than ₱ 1000 ☐ Please specify: ___

20) Which of the following organisations would you trust to manage these funds? Please tick ☑ all that apply.
- ☐ Barangay/community council
- ☐ Municipal government
- ☐ Department of Environment and Natural Resources (DENR)
- ☐ Partnership between the government and non-government organisations (NGOs)
- ☐ Others, please specify: ______________

21) What method of payment would you consider acceptable? Please tick ☑ all that apply.
- ☐ Collection through the barangay
- ☐ Fee included in properties
- ☐ Fee included in electricity bill
- ☐ Others, please specify: ______________

22) Please indicate your level of agreement to the following statements. Please tick ☑ appropriate one for you.

	Strongly agree				Strongly disagree
Abundant forests help keep water clean.	☐	☐	☐	☐	☐
Forests are unimportant even for non-use purposes (such as protection against climate change).	☐	☐	☐	☐	☐
Abundant forest increases erosion.	☐	☐	☐	☐	☐
Forests slow down flood waters, for example, as a result of extreme weather events, to help reduce flooding.	☐	☐	☐	☐	☐
I am committed to my faith.	☐	☐	☐	☐	☐
I am gainfully and securely employed.	☐	☐	☐	☐	☐
I am in good health.	☐	☐	☐	☐	☐
Roads in my neighbourhood are bad and unreliable.	☐	☐	☐	☐	☐
My household is financially secure.	☐	☐	☐	☐	☐
My network of family and friends is available and reliable.	☐	☐	☐	☐	☐
I do not participate in community-related activities.	☐	☐	☐	☐	☐
Rivers are important for non-use purposes (such as preserving rivers for future generations).	☐	☐	☐	☐	☐
I want to prevent the risk of flooding in my community.	☐	☐	☐	☐	☐
I want future generations to enjoy a flood-free	☐	☐	☐	☐	☐

community.					
There are other more important problems that need funding (other than preventing/avoiding flooding in my neighbourhood).	☐	☐	☐	☐	☐
I do not believe that the fund would produce the promised levee banks (the money might just be wasted).	☐	☐	☐	☐	☐
I do not believe that the levee banks would prevent future flood damages.	☐	☐	☐	☐	☐
I do not care about the problems of flooding.	☐	☐	☐	☐	☐
I do not believe that my household is at risk of being flooded.	☐	☐	☐	☐	☐
I am not prepared to pay anything to minimise flooding unless others pay too.	☐	☐	☐	☐	☐

SECTION 5: *About you and your household*

23) Age: ________ (in years)

24) Gender: ☐ Male ☐ Female

25) Religion
- ☐ Roman Catholic
- ☐ Protestant
- ☐ Muslim
- ☐ Others, please specify: ________________

26) Number of years in school: ________

27) Are you ....
- ☐ employed *(go to Question #29)*
- ☐ unemployed (but looking for employment) *(go to Question #30)*
- ☐ an unpaid domestic worker *(go to Question #30)*
- ☐ retired *(go to Question #30)*

28) If employed, which sector do you work in?
- ☐ Industry (e.g. mining, quarrying, manufacturing, construction, etc.)
- ☐ Agriculture, fisheries and forestry
- ☐ Services (e.g. transportation, communications, tourism, government and private services, storage, trade and finance, etc.)
  - Does the *majority of your work operations involve tourists (local and/or international)?*
  - ☐ Yes
  - ☐ No
- ☐ Others, please specify: ____________________

If employed, what is the status of employment
- ☐ Permanent
- ☐ Casual/temporary
- ☐ Others, please specify: ____________________

29) Monthly household income (₱)

Source of income	Income range	Does this source of income depend on the availability of rivers in your neighbourhood?		Does this source of income depend on the availability of forests in your neighbourhood?		Does this source of income depend on the availability of other natural resources in your neighbourhood?	
		☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ No
		☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ No
		☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ No
		☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ No
		☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ No
		☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ No

Source of income, e.g. employment, pension, remittance, interest from savings/investments, etc.
Income range

1) ₱ 2,000 and below
2) 2,001 – 4,000
3) 4,001 – 6,000
4) 6,001 – 10,000
5) 10,001 – 14,000
6) 14,001 – 18,000
7) 18,001 – 24,000
8) 24,001 – 30,000
9) 30,001 – 36,000
10) Above 36,000

30) What percentage of the all food across an entire year does you and/or your household grow/catch?

0	20%	40%	60%	80%	100%
☐	☐	☐	☐	☐	☐

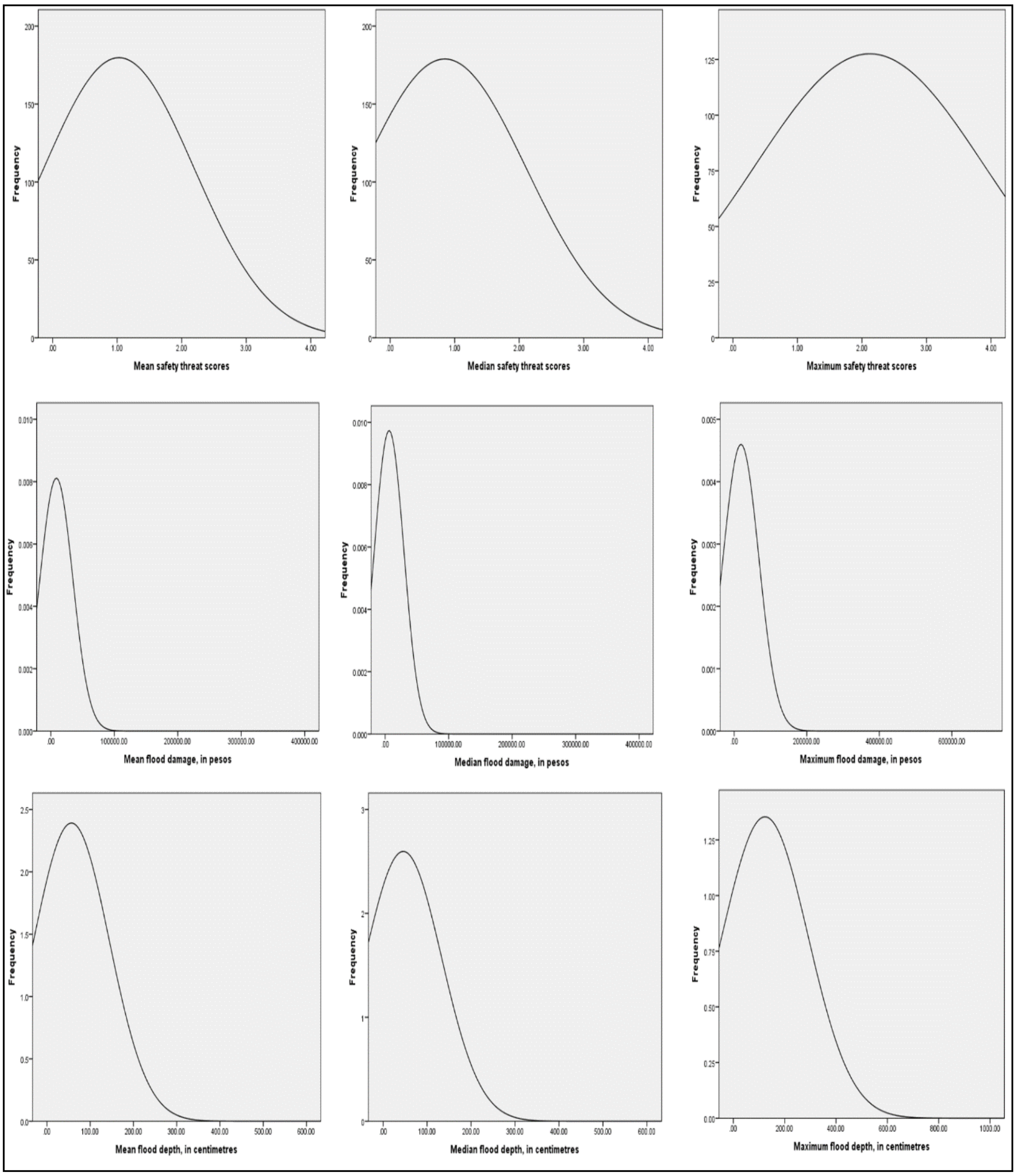
31) Do you own the house you are living in?

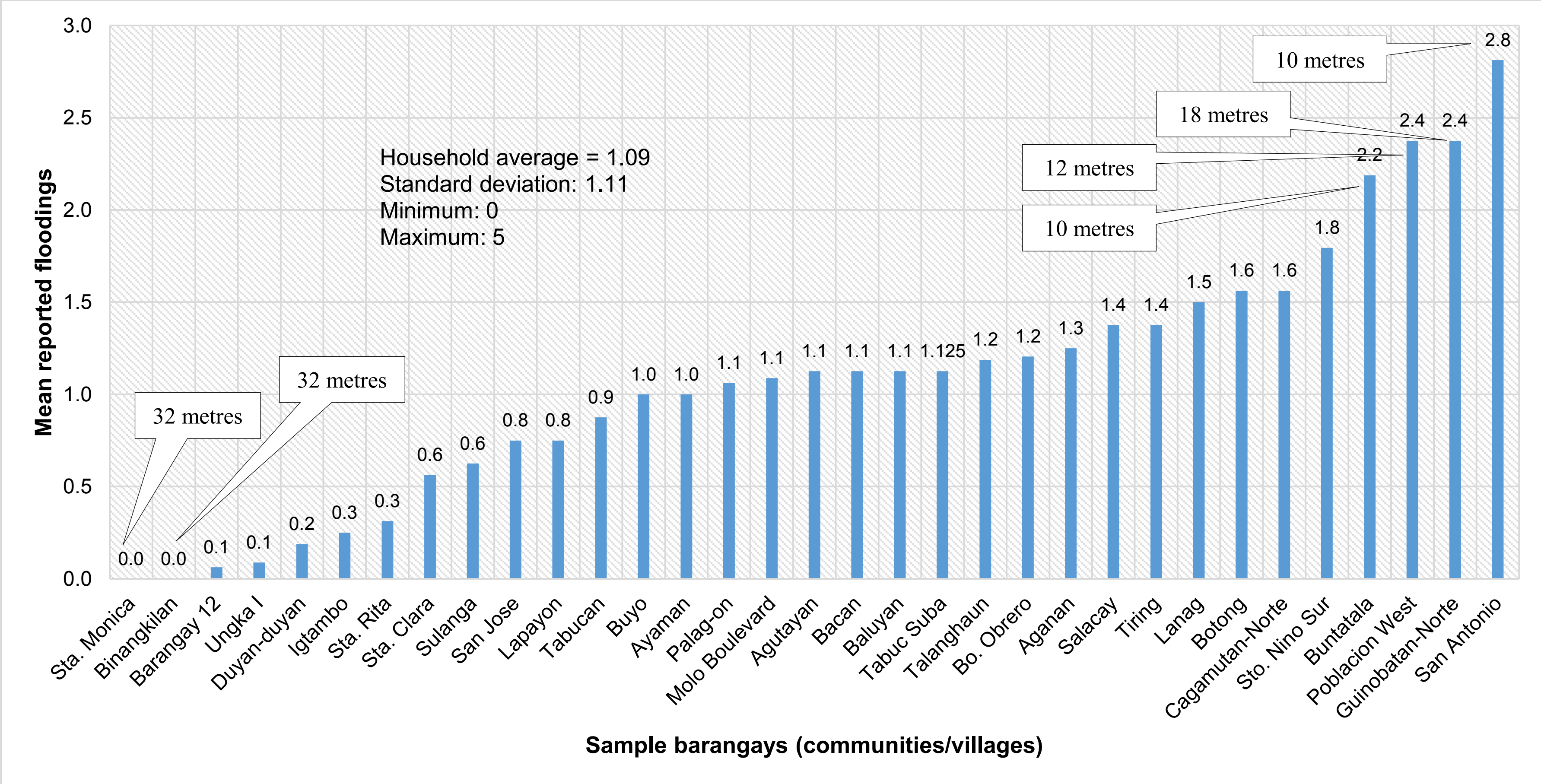
☐ Yes
☐ No, I rent the house
☐ No, other arrangement, please specify: ________________

32) Number of family members living in your household, including yourself: ____
Number of children (i.e. 16 years old and below) living in your household: ____

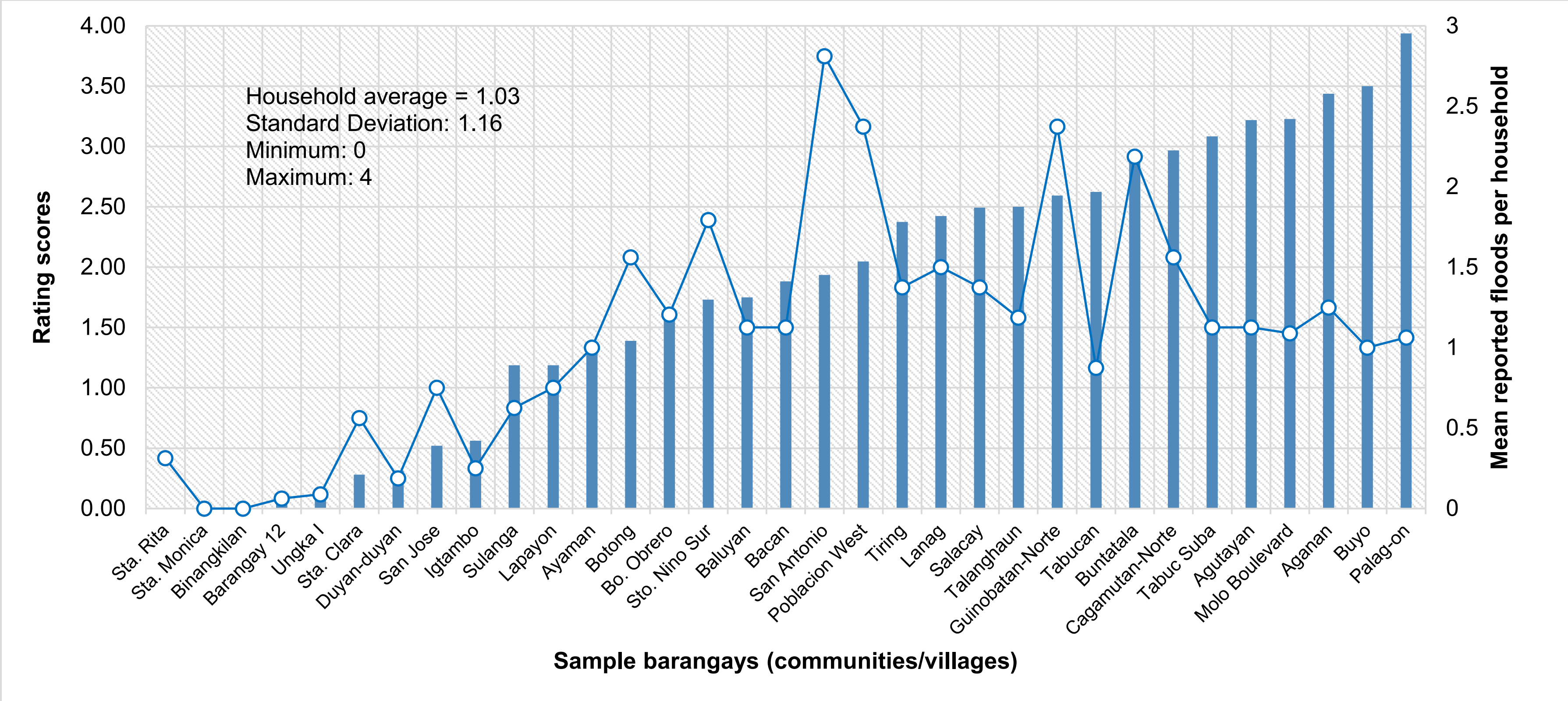
End of survey

Appendix I: Distribution some reported flood impacts.

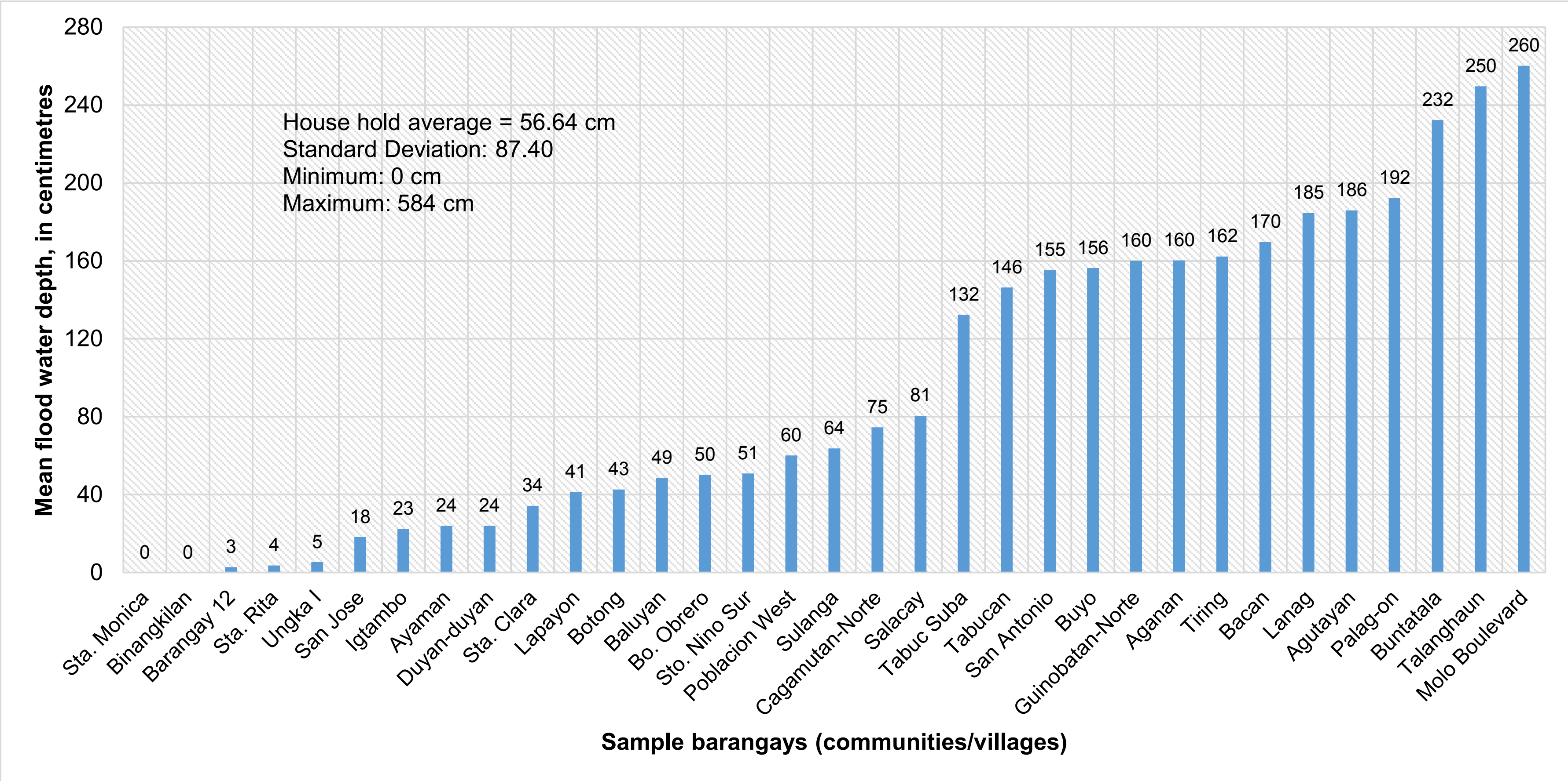




Appendix J: Mean reported floods per household, across locations.



Appendix K: Mean safety threat scores and mean flood incidences per household, across locations.



Appendix L: Mean depth of flood water per household, across locations.

Appendix M: Income compensation derived from the life satisfaction (LS) model.

Using the results from the life satisfaction regression, I discussed the steps in calculating how much individuals need to be compensated with flood damages incurred. In here, I used the median flood damages. From Equation 1, I can derive $\frac{dLS}{dFD(median)}$.

$$LS_i = \alpha + \beta_1 \ lnY_i \ + \beta_2 \ lnFD_i(median) + \beta_3 \ lnFD_i(relativemedian) \ + \delta X_i + \ \varepsilon_i \qquad (1)$$

$$\frac{dLS}{dFD(median)} = \left[\frac{d(\alpha+\beta_1 \ lnY+\beta_2 \ lnFD(median)+\delta X)}{dFD(median)}\right] \qquad (2)$$

$$\frac{dLS}{dFD(median)} = \left[\beta_2 \frac{1}{FD \ (median)}\right] \qquad (3)$$

Also from Equation 1, I can derive, $\frac{dLS}{dY}$.

$$\frac{dLS}{dy} = \left[\frac{d(\alpha+\beta_1 \ lnY+\beta_2 \ lnFD(median)+\delta X)}{dY}\right] \qquad (4)$$

$$\frac{dLS}{dy} = \left[\beta_1 \frac{1}{Y}\right] \qquad (5)$$

I equate (3) and (5) to derive Y, the income compensation.

$$\frac{dLS}{dFD(median)} = \frac{dLS}{dY} \qquad (6)$$

$$\left[\beta_2 \frac{1}{FD \ (median)}\right] = \left[\beta_1 \frac{1}{y}\right] \qquad (7)$$

$$Y = FD \ (median) \left[\frac{\beta_2}{\beta_1}\right] \qquad (8)$$

From OLS regression in Equation 1, I derived the value of income for every change on flood damage: $\widehat{\beta_1}$ =2.926 and $\widehat{\beta_2}$ = -0.574. Therefore,

$$Y = FD \ (median) \left[\frac{-0.574}{2.926}\right] \qquad (9)$$

$$Y = FD \ (median)[-0.196] \qquad (10)$$

From (10), if individuals were to experience an additional flood damage of ₱1,000 over five years, they will need an extra income of approximately ₱196 pesos.

The same procedure (steps 1 to 8) is adopted to look at the income compensation using the relative flood damage coefficient (assume that $\widehat{\beta_3}$ = -0.634). From here,

$$Y = FD \ (relative, median) \left[\frac{-0.634}{2.926}\right] \qquad (11)$$

$$Y = FD \ (relative, median)[-0.217] \qquad (12)$$