Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 6, No. 3, p. 84-90, 2015
http://www.innspub.net

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RESEARCH PAPER
OPEN ACCESS

The value of flood risk reduction in selected communities near the pulangui river in bukidnon, Philippines

Michael Arieh P. Medina and Jocereal G. Arche

Department of Environmental Science, College of Forestry and Environmental Science, Central Mindanao University, University Town, Musuan, Bukidnon, Philippines

Article published on March 02, 2015

Key words: Flood Risk Reduction, Contingent Valuation, Regression Analysis, Pulangui River.

Abstract

To estimate the economic value of the benefits of a structural flood prevention program in flood prone areas near the Pulangui River in Bukidnon, Philippines, a contingent valuation study using the willingness to contribute labor (WTCL) format was conducted. The study also explored the socio-demographic determinants of WTCL in order to determine the factors influencing the residents' future contribution of voluntary labor in a flood prevention project. A survey was conducted in three flood prone barangays in the province of Bukidnon namely: Batangan, Valencia City; Dologon, Maramag; and Camp 1, Maramag. A bidding game procedure was employed to reveal their WTCL. The results showed that the respondents are willing to contribute an average of 10.02 man days of labor in a flood prevention program per year. Interestingly, this is greatly higher than results from similar studies abroad. Consequently, the economic value of the benefits of residents from a structural flood prevention project is estimated at around PHP 3M per year based on the minimum daily wage rate. Using multiple linear regression, gender and poverty revealed significant influences on the respondents' WTCL. Male respondents and those with higher income are more likely to contribute labor than those of the opposite gender and income class.

***Corresponding Author:** MAP Medina ✉ mapmedina@cmu.edu.ph

Introduction

Residents of the Province of Bukidnon specifically those living near the banks of Pulangui River have been victimized by flood through time which leads to loss of property and lives. Frequent flooding has been attributed to both global (climate change) as well as local (deforestation, improper land use, etc.) environmental crises (Bankoff 2003). Several programs have been devised to address this problem (Montz and Gruntfest 2002; Shaw 2006). One of these is relocation which is one of the main options to avoid the worst consequences brought about by future floods in the area. However, due to economic and social reasons, relocation is a hard possibility among residents (Lin *et al* 2007; Kick *et al* 2011).

On the other hand, although structural flood control measures do not guarantee full protection (Kundzewicz and Takeuchi 1999), some are proven to be effective in mitigating flood impacts (Hsieh *et al* 2006). However, governments are hesitant with such projects due to high construction costs (Kundzewicz and Takeuchi 1999), but we can justify such programs if we can provide evidence that the benefit is greater than the cost (Shabman *et al* 1998). The next step lies with the quantification of the said benefits, the value of which can be measured through "contingent valuation method" (CVM).

CVM is popularly utilized in the field of environmental economics in order to obtain value for non-market commodities such as ecosystem services. In the context of this study, residents' benefit from a structural flood prevention program is assumed as a non market commodity. In contingent valuation, questions are asked to help reveal the monetary value of the tradeoff that a person makes in relation to the value of goods or services in question (Carson 2012) thereby revealing an economic (monetary) value for such goods and services.

The most common way to do contingent valuation is through the asking of an individual's "willingness to pay" (WTP). Several studies have been done using WTP to estimate the benefits of flood mitigation programs as reviewed by Reynaud and Nguyen (2013). However, WTP creates a problem when conducted in low income countries due to the large turnout of protest bidders (those who are not willing to pay) as well as low bidders (because they can't afford to pay, thereby understating the real value) (Brouwer *et al* 2009).

To address the above problem, an alternative way of revealing such value is through "willingness to contribute labor" (WTCL) which has been proven to be more effective in developing countries than WTP (Casey 2003; Tilahun *et al* 2011; Navrud *et al* 2012; Schiappacasse *et al* 2013). People with low income who cannot be able to pay for a public good are mostly willing to contribute labor in replacement of money.

In Mexico, WTCL was used to determine farmers' willingness to work in forest conservation (Casey 2003). Tilahun *et al* (2011) also did a contingent valuation of forest conservation using WTCL in Ethiopian households. In Schiappacasse *et al* (2013), WTCL was used in determining the participation of households in forest restoration in Chile.

In terms of CVM studies of flood prevention projects, WTP is commonly used such as in the study done by Brouwer *et al* (2009) in Bangladesh and by Reynaud and Nguyen (2013) in Vietnam. WTCL was only used recently in Vietnam by Navrud *et al* (2012). In the Philippines, CVM is mostly used in valuing ecosystem services which commonly uses the WTP format (Jolejole and Briones 2010; Manlosa *et al* 2013; Subade and Francisco 2014; Ureta *et al* 2014). Currently, there are no WTCL studies done specifically on flood risk reduction in the country which can be found in published literature as previously surveyed by the authors.

Thus, this study will fill the above research gaps – the feasibility of using CVM especially WTCL in valuing flood risk reduction. Specifically the study aims to: 1) provide baseline data on the value of the residents' benefit from future construction of flood prevention structures in their area. This can be utilized for future cost benefits analyses which can help justify the

prioritization of such projects in the future; and 2) because WTCL can be equated to the level of community participation (Lankia *et al* 2014), the study will also try to determine the factors that determine household participation in such flood prevention projects which answers the call for community based disaster management (Laska 1986; Irvin and Stansbury 2004; Delica-Willison 2005; Shaw 2006; Działek *et al* 2013) which, in the future, may need voluntary labor to save construction cost.

Aims of the study

The following are the aims of the study:

1. To quantify the economic value of the benefits derived from a flood risk reduction project in the area.
2. Identify the determinants of the residents' participation in a flood prevention program.

Materials and methods

Study area

The study was conducted in 3 flood prone barangays in Bukidnon which are found along the banks of Pulangui River. The following areas are: Brgy Batangan in Valencia City (Purok 1 and 2), Brgy. Dologon in Maramag Town (Purok 7 and 12), and Brgy. Camp 1 which is also in Maramag Town (Purok 4) (See Fig. 1).

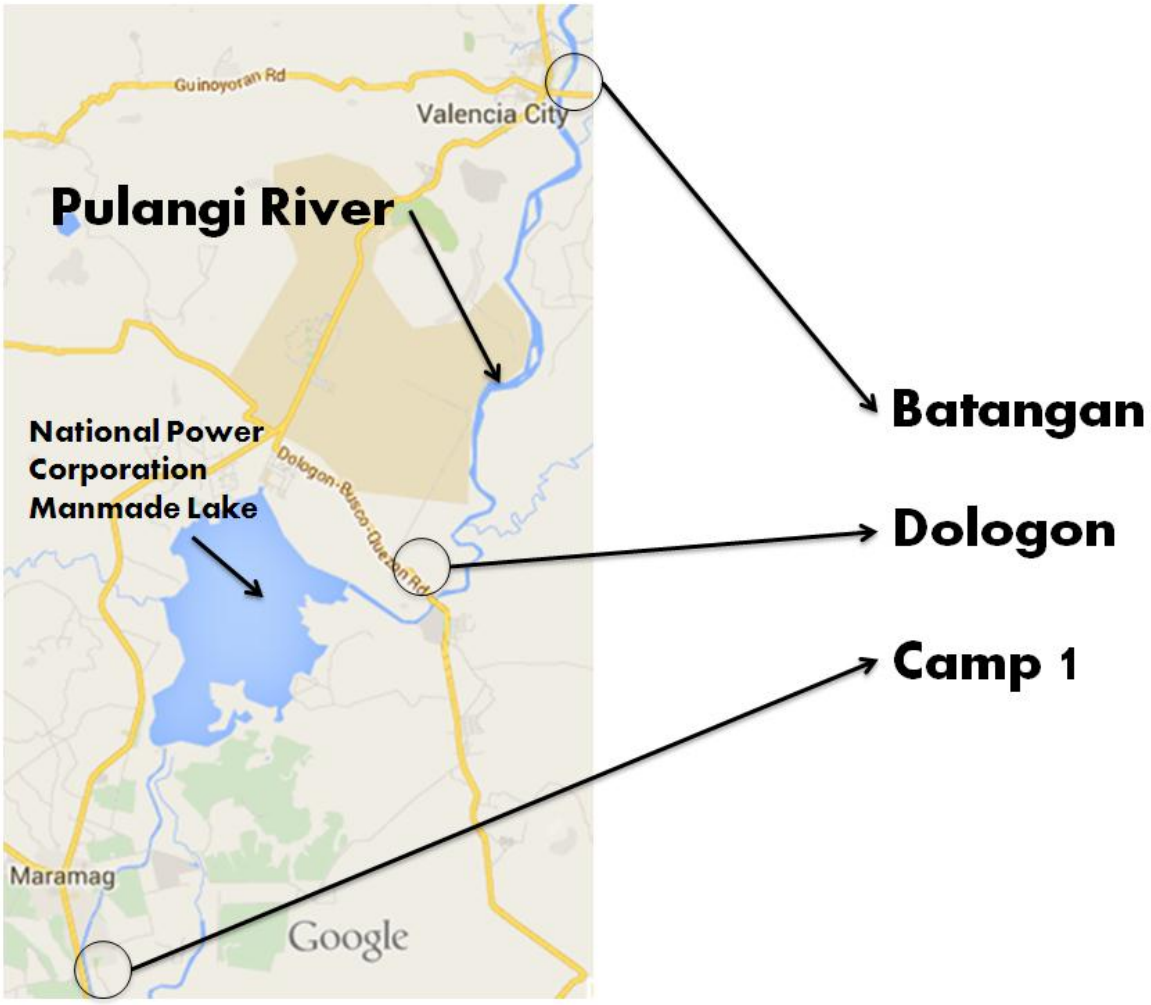

Fig. 1. Location of the Study Areas.

Respondents

The respondents of the study is composed of a sample of flood victims particularly during the December 27, 2011 flood incident. Based on the data from the Local Disaster Risk Reduction and Management Councils of both local governments, a total of 1,046 households were affected by the mentioned flooding incident (Batangan = 919, Dologon = 87, Camp 1 = 40).

Due to financial and time considerations, convenience sampling was done in the identification of respondents for the study. Out of the 1,046 affected households 91 respondents were interviewed in the study (Batangan = 36, Dologon = 33, Camp 1 = 22).

Data gathering procedure

Data were gathered using a survey questionnaire. Based on Navrud *et al* (2012) The main part of the questionnaire is the contingent valuation format which is composed of 2 major questions: 1) *Are you willing to contribute labor to a flood prevention program that would completely avoid the damages you had experienced in repetitive flood occurrences in your area?*, 2) *If the answer to the first question is YES, what is the most number of man-days your household would be willing to contribute per year?*

A bidding game procedure was employed in soliciting the household WTCL in the second question above. Their first answer will be doubled each time they agree on a certain number until they disagree. Then, it will be deducted by 1 until they agree again on a certain number. That last number serves as the WTCL of that particular respondent.

Data analysis

Descriptive statistics was employed in data analysis such as mean, and frequency counts. Furthermore, a Multiple Linear Regression Analysis was employed in the determination of factors that influences the WTCL of the respondents.

Results and discussions

Willingness of respondents to contribute labor

In contradiction to previous WTP and WTCL studies which has a certain number of protest bidders (those not willing to pay or contribute labor), all of the respondents in the study responded yes when asked if they are willing to contribute to a hypothetical flood prevention project in their area. This means that all of the respondents support this type of project. Furthermore, this clearly reflects the efficiency of using WTCL in contingent valuation for developing countries compared to WTP which usually results to high probability of protest bidders which defeats the purpose of a valuation study.

Reason for willingness to contribute

As shown in Table 1, the main reason why they are willing to contribute labor is for the benefit of their family. This reflects the awareness of the respondents on the importance of a flood prevention program for their own benefit. The next common reason why they are willing to contribute labor is for the protection of the community. Others also signified their support for the project by answering that "they want to help". This means that almost half of the respondents' are willing to contribute labor for personal/family reasons while the majority reflects an altruistic/humanitarian reason for contributing labor. However, it should be noted that this item in the questionnaire is a single response question thus we can actually assume that if given a chance to choose a second response, they would also reveal an altruistic reason for contributing labor.

Table 1. Respondents' reasons for contributing labor (N = 91).

Reasons	Frequency	Percentage
For the benefit of my family members	42	46
To protect the whole community	31	34
I want to help	18	20
Total	**91**	**100**

Respondents' WTCL

As shown in Table 2, Batangan has the highest WTCL value in man days per year (10.53) followed by Dologon (10.45) then Camp 1 (8.55). The average value for all the respondents is 10.02 man days per year. This is almost twice than the reported WTCL in

a study conducted in Vietnam which is 6.73 man days per year (Navrud 2012).

Table 2. Willingness to Contribute Labor (WTCL) by Barangay with equivalent monetary value.

Barangay	N	Annual Average Labor Contribution (Man Days/Year)	WTCL Average Annual Monetary Value (PHP)*
Batangan	36	10.53	3,168.86
Dologon	33	10.45	3,146.82
Camp 1	22	8.55	2,572.18
Total	**91**	**10.02**	**3,016.61**

**WTCL multiplied with PHP 301.00 (Average daily minimum wage rate for non-agricultural labor for Valencia City and Maramag, Bukidnon) (Source: DOLE-NWPC, 2014)*

Economic value of benefits from flood risk reduction

WTCL was converted to monetary value by multiplying it by the minimum daily wage rate in Bukidnon. The conversion showed that the average labor monetary value is PHP 3,016.61 per household.

To have a conservative estimate of the economic value of the benefits from the flood prevention project, the number of reported households affected by flood typically from the December 27, 2011 flood incident (N = 1046) was multiplied with the average WTCL of the respondent households. This revealed a value of PHP 3,155,374.06 per year. Furthermore, if we hypothesize a flood prevention project that would take 5 years to finish, this would reveal a value worth PHP 15,776,870.3.

This may not be much to justify a flood structure which may have an actual cost of billions of pesos, however, it should be pointed out that the multiplier used is limited only to the number of reported flood victims in the study area (N = 1046). The estimated value does not include the number of household flood victims from other areas especially downstream of the hypothesized project that can undeniably be benefitted. Furthermore, the labor wage value used is a minimum which clearly is not true to all of the respondents. This means that the values presented here is an underestimate of the value of the benefit of a flood prevention program but nevertheless, this gives us an idea that the more accurate value cannot be lower than this.

Moreover, we should also consider the fact that the above estimate refers only to the direct benefits by the flood victims. There are also indirect benefits in terms of avoidance of impacts of flood damages aside from households such as businesses as well as local governments.

Determinants of WTCL

Using multiple linear regression analysis, several socio-demographic variables were explored and tested if it influences the dependent variable (WTCL). The final regression model revealed two independent variables that significantly influence WTCL – gender and poverty as shown in Table 3.

Table 3. Regression Model for Willingness to Contribute Labor (WTCL) in Man Days.

Variables	Description of Variables	Regression Coefficients (B)	Standardized Regression Coefficients (β)	p-value
Constant		10.311		0.000
Gender	Gender of Respondent (male = 1; female = 0)	1.590	0.214	0.041
Poverty	Household Monthly Income of Respondent (below poverty threshold = 1; above poverty threshold = 0)	-1.338	0.207	0.048

Gender was dummy coded (male = 1, female = 0) along with poverty (respondents below the poverty threshold of ~PHP 5000.00 per month = 1, respondents above the poverty threshold = 0) and

entered into the regression analysis. In Table 3, based on the regression coefficients (B), the model shows that male respondents are more likely to contribute more than a day (1.59 days/year) than female respondents. Culturally, males being masculine are expected to contribute more labor than women especially if it refers to construction labor.

Furthermore, poverty poses a negative influence on WTCL. Respondents above the poverty threshold are likely to contribute more than a day (1.34 days/year) than respondents below the poverty threshold. As expected, poor families do not have the luxury to provide voluntary work compared to those who are well off. This could be the reason for such relationship.

In terms of the standardized regression coefficients (β), gender has a higher value than poverty. This means that to a certain degree gender influences the WTCL of respondents more than poverty.

Conclusions

The respondents of the study is found to be supportive of a structural flood prevention project in their area and they are able to reveal the value of the project's benefits to them in terms of their willingness to contribute labor (WTCL). In fact, the WTCL for flood prevention program in this study is almost twice than what was observed abroad.

When converted to monetary value, the benefits that flood victims can get from the hypothetical flood prevention project is worth around 3 million pesos per year or around 15 million pesos in five years. Although this is an underestimate, this would mean however that the value of the benefits cannot be lower than the said value but rather higher especially if we consider the indirect benefits that the project will bring to other sectors in the community. Such estimate can be helpful in future cost benefit analysis of such type of project in the area.

Furthermore, male residents are more likely to contribute labor to a flood prevention project in the area than women respondents. Respondents with higher income are also more likely to contribute more days of labor than those with low income. This information can be helpful in the case of future community based flood prevention programs which may rely on voluntary labor.

Acknowledgements

The authors would like to thank the local government units of the study areas for providing the secondary data used in this study.

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