Willingness to pay for flood insurance: a case study in Phang Khon, Sakon Nakhon Province, Thailand

S Paopid\textsuperscript{1,5}, J Tang\textsuperscript{2,3}, and N Leelawat\textsuperscript{1,3,4}

\textsuperscript{1}Risk and Disaster Management Program, Graduate School, Chulalongkorn University, Phayathai Road, Pathumwan, Bangkok 10330 Thailand
\textsuperscript{2}International School of Engineering, Faculty of Engineering, Chulalongkorn University, Phayathai Road, Pathumwan, Bangkok 10330 Thailand
\textsuperscript{3}Disaster and Risk Management Information Systems Research Group, Chulalongkorn University, Phayathai Road, Pathumwan, Bangkok 10330 Thailand
\textsuperscript{4}Department of Industrial Engineering, Faculty of Engineering, Chulalongkorn University, Phayathai Road, Pathumwan, Bangkok 10330 Thailand
\textsuperscript{5}E-Mail: soonthorn.pao@gmail.com

Abstract. Long droughts and floods can reduce agricultural productivity and negatively impact upon businesses in the agriculture and food industries. The prevention and response to floods require both public and private efforts (e.g., “Pay for Flood” insurance) for utmost effectiveness. The purpose of this study was to determine the potential factors that influence the people of Phang Khon District, near the Nam Un Dam, in paying flood insurance. The regression results showed that the height and duration of flooding, house price, and flood damage, were all key factors that triggered the willingness to pay flood insurance. In contrast, having a house with stairs decreased the likelihood of paying insurance. Our research suggested that 12.69 - 19.04 USD/month is a commonly accepted flood insurance premium in Thailand. These findings can guide governments and insurance providers and companies towards improving their flood insurance practices.

Keywords: Contingent Valuation Method, Flood Insurance, Willingness to Pay, Sakon Nakhon, Thailand

1. Introduction
Sakon Nakhon Province is the leading province in the upper north-eastern region of Thailand, which has experienced rapid economic growth [1]. This is largely due to the province being a trading and investment centre, possessing a geographical advantage over neighbouring countries (Lao People’s Democratic Republic, Cambodia, Vietnam and southern China), especially after the opening of the 3rd Thai-Laos Friendship Bridge in Nakhon Phanom Province (approximately 90 km from the area), and the 2nd Thai-Laos Friendship Bridge in Mukdahan Province (approximately 120 km from the area). In addition, there are more factors that cause economic growth in this province including its large area, which encompasses more than 18 districts. Nevertheless, Sakon Nakhon faces frequent floods as the Phang Khon District has medium and large sizes rivers and dams, with windstorms and landslides also major problems in this area.

In Thailand, the rainy season generally lasts from May to September, with many areas experiencing heavy rainfall and large amounts of water flowing over the area than usual. The subsequent flooding
enters various areas containing communities, which do not have an effective drainage system, resulting in damage to agricultural land and property. Previous flooding statistics between the years 2015 - 2017, and carried out on 16 districts (44 sub-districts) and 478 villages, covering a total agricultural area of 107.344 km², have demonstrated that there is high frequency of flooding and raw mudslides [2]. The area is particularly vulnerable as its located adjacent to the main rivers in the province, namely the Songkram River, Yam River, Namphung River, and Namkham River. In 2017, the impact of flooding across each of the districts in the area, resulted in 431,277 cases of suffering, with 136,825 households affected, causing 737 houses to be damaged, 11 human and 906,372 livestock deaths, and 8,303 fisheries, 13 temples, 19 schools, 6 government offices, 604 roads, 18 bridges, 21 waterworks, and 37 reservoirs/weirs to sustain damage. The area that was most affected was the Phang Khon District [2], receiving excess water from the nearby Nam Un and Nam Phueng Dams, and the medium and large-sized reservoirs. The flooding caused a high fatality rate and a large number of injuries mainly due to road accidents, the leading cause of death around the world. In addition, there are other consequences, such as the damage to family and society, loss of medical expenses, loss of labor, and psychological and economic impacts. The local population, which lives near the Nam Un Dam, have several disaster prevention measures related to flood risk reduction in place, including the opportunity to purchase disaster insurance. However, it is largely left to a person own free will to make any appropriate insurance arrangements. Therefore, it is important to address the factors, which may influence a person’s willingness to pay for flood insurance, including the amount of payment for disaster insurance. The target area of this study is the Phang Khon District in Sakon Nakhon Province, Thailand. This research considered one representative of each household as the sample, with the scope set to cover particularly vulnerable people (i.e., living within 1 km from Nam Un Dam). The study objective was to firstly determine the factors and behaviour that influence a person’s willingness to pay (WTP) for flood insurance. Secondly, to assess the valuation of insurance by assessing the willingness to pay for disaster insurance across each area.

2. Materials and Methods

2.1. Willingness To Pay (WTP)
Field and Olewiler [3] summarized the WTP concept as a fundamental economic concept that is related to individuals having preferences for services and goods. It is recommended that flood insurance be a proactive part of private sector risk management in order to protect from big losses. The self-stated WTP for insurance is an important index to demonstrate the individual effort that a person puts into the risk management of a disaster. However, the majority of people still consider that the public sector should take the full responsibility for disaster risk management. This has led the WTP for flood insurance not necessarily increasing with a higher flood risk perception [4]. Therefore, it is important to understand the factors which motivate the local population’s WTP, including their valuation of insurance.

2.2. Contingent Valuation Method (CVM)
The CVM is a tool that is utilized for assessing the value of WTP in terms of estimating the environmental cost of an adverse natural resource or climate related event, which is a non exchanged market good or service (i.e., not bought or sold directly). The valuation is based on questioning the people that are, or will, be affected by environmental changes. Specifically, the CVM framework asks consumers, or members of the general public, their WTP to support the improvement of natural resources and the environment. As in a CV scenario, examples are provided and compensation measures are provided using Open-Ended and Close-Ended questions, as follows:

1) Open-Ended: a questionnaire is provided to the respondents related to the satisfaction of their WTP in the context of the study (i.e., flooding). The respondents can provide unlimited information on the questionnaire; however the interviewer may encounter results and information that are unable to be included in the study.
2) Close-Ended: a questionnaire is provided to the respondents that does not provide the real value of the resources or the environment being studied, resulting in higher or lower values than what the question asked [5].

2.3. Related literature review
The summary of the factors related to the CVM Model and related research are summarized in Table 1.

| Authors                  | Type of Questions                                                                 | Factors that affected                                      | Methodology                           |
|--------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------|---------------------------------------|
| Sukharomana [6]          | CVM dichotomous choice, Closed-Ended Double Bounded                                | - Education                                               | Censored Regression Model, Maximum Likelihood Estimation |
|                          |                                                                                   | - Income                                                  |                                        |
|                          |                                                                                   | - Age                                                     |                                        |
|                          |                                                                                   | - Risk from water quality                                 |                                        |
| Cohen et al. [7]         | Close-Ended Double Bounded                                                        | - Income                                                  | Logistic Regression Equations          |
|                          |                                                                                   | - Risk of crime                                           |                                        |
|                          |                                                                                   | - Household population                                    |                                        |
| Bunto et al. [8]         | Close-Ended Questionnaire, Open-Ended Questionnaire                                | - Education                                               | Multiple Linear Regression Analysis and Logistic Regression Model Bidding Game |
|                          |                                                                                   | - Income                                                  |                                        |
|                          |                                                                                   | - Age                                                     |                                        |
| Wang et al. [9]          | Open-Ended                                                                         | - Income                                                  |                                        |
|                          |                                                                                   | - Education level                                         |                                        |
|                          |                                                                                   | - Decreases with household population                     |                                        |
|                          |                                                                                   | - Age                                                     |                                        |
| Phumiprapat et al. [10]  | Double Bounded Close-Ended                                                         | - Flooding period                                         | Censored Regression Model             |
|                          |                                                                                   | - Drought period                                          |                                        |
|                          |                                                                                   | - Bid                                                     |                                        |
| Sriprasong [11]          | Closed-Ended Double Bounded                                                       | - Age                                                     | Censored Regression Model, Maximum Likelihood Estimation |
|                          |                                                                                   | - Net profit(entrepreneur)                                |                                        |
|                          |                                                                                   | - Knowledge and the understanding of tax                   |                                        |
| Kittiatthaphong [12]     | Close-Ended single bound dichotomous choice                                        | - Bid                                                     | Logit Model                           |
|                          |                                                                                   | - Income                                                  |                                        |
|                          |                                                                                   | - Age                                                     |                                        |
|                          |                                                                                   | - Education                                               |                                        |
|                          |                                                                                   | - Marital Status                                          |                                        |
| Nawasod and Pattanarangsan [13] | Close-Ended Questionnaire, Open-Ended Questionnaire                             | - Occupation                                              | Censored Regression Model, Maximum Likelihood Estimation |
|                          |                                                                                   | - Environment                                             |                                        |
|                          |                                                                                   | - Degree of severity of Hygiene, air pollution            |                                        |
| Theerawattanakuul [14]   | Closed-Ended Double Bounded                                                       | - Income                                                  | Censored Regression Model, Maximum Likelihood Estimation |
|                          |                                                                                   | - Bid                                                     |                                        |
|                          |                                                                                   | - Concern                                                 |                                        |
| Srinark et al. [15]      | Closed-Ended Double Bounded                                                       | - Income                                                  | Logistic regression                   |
|                          |                                                                                   | - Bid                                                     |                                        |
|                          |                                                                                   | - Concern                                                 |                                        |
Based on previous literature (see Table 1), the type of questions, methodology, and potential factors considered in this research included, age, income, and bid price. According to previous flood insurance-related studies, the potential factors included, house price, damage, loss of revenue, and the period.

3. Research design and methodology
This study defined a conceptual framework which involved the research variables being categorized into 3 groups: (1) Physical Factors (e.g., homeowner, price of house, stairs, age, generation, income), (2) Impact factors (e.g., price of house, damage, flood level), and (3) Behaviour Factors (e.g., bid price, willingness level). The community’s vulnerability and WTP for flood insurance was conducted using the market price as a simulation study. A questionnaire survey was used as the tool for primary data collection. A Multiple Linear Regression Analysis model was then used and compared against a Logistic Regression model; developed following equation (1).

\[
WTP = \beta_0 + \beta_1 \text{Insurance}_i + \beta_2 \text{Gen}_i + \beta_3 \text{Age}_i + \beta_4 \text{Status}_i + \beta_5 \text{Edu}_i + \beta_6 \text{Occ}_i + \beta_7 \text{Income}_i + \beta_8 \text{Houseowner}_i + \beta_9 \text{Numh}_i + \beta_{10} \text{Houseprice}_i + \beta_{11} \text{Agehouse}_i + \beta_{12} \text{Stairs}_i + \beta_{13} \text{Damage}_i + \beta_{14} \text{Height}_i + \beta_{14} \text{Duration}_i + \epsilon_i
\]  

Where \(WTP\) is Willingness To Pay for flood insurance; \(Insurance\) is knowing if there are insurance disasters (know/don’t know); \(Gen\) is gender (male/female); \(Age\) is age of respondents (years); \(Status\) is status (single/marriage/divorced/widowed/separated); \(Edu\) is the respondents education level (years); \(Occ\) is occupation, and included farmer, government staff and business owners; \(Income\) is income per household (USD); \(Houseowner\) is ownership of the house during the flood period (yes/no); \(Numh\) is number of households; \(Houseprice\) is house price in this area (USD); \(Agehouse\) is age of house (years); \(Stairs\) is number of floors of the house (floors); \(Damage\) is the value of damage, loss of revenue (USD); \(Height\) is the level of the water inside the house (meters) during the flood period; \(Duration\) is the period of flooding in the house (days); \(WTP2\) is the starting bid price (USD), which is set to be a quantitative variable; and \(WTP3\) is the starting bid price (USD), which set to be a quantitative variable; and \(\epsilon_i\) is error estimated.

4. Results
The included population size was 30,258 households across 3 sub-districts, including Rae, Muang Khai, and Haiyong. Based on the error of 5 percentage rule [16], 395 samples were required for our survey, however a total of 401 survey respondents were collected from 15 April to 15 May 2020. The demographic information of all respondents is shown in Table 2. There were 339 (84.5%) respondents who had experienced a flood, but only 181 (46.3%) of the respondents had received government compensation. In addition, only bought private flood insurance, which is extremely low, with the majority of respondents only receiving minor flood damage compensation (<158.66 USD) from a flood level less than 1 meter.

| Table 2. Demographic profile of the respondents |
|-----------------------------------------------|
| **Factor** | **Frequency** | **Percentage %** |
| Impact Flood | | |
| Yes | 339 | 84.5 |
| No | 62 | 15.4 |
| How to prevent flooding | | |
| No | 157 | 53.4 |
| Property insurance | 1 | 0.3 |
| Government compensation | 181 | 46.3 |

| **Factor** | **Frequency** | **Percentage %** |
| Knowing there are insurance disasters | | |
| Yes | 28 | 7.0 |
As shown in Table 3, the results showed that a WTP flood insurance premium of 19.04 (USD) were accepted by 21 persons (6.2%), while 318 persons (93.8%) had no WTP. An insurance premium of 25.39 (USD) was accepted by 3 persons (0.9%), while 336 persons (99.1%) had no WTP. However, as shown in Table 2, most of the respondents were farmers, with most respondents having a low-income range (Table 4). Moreover, for the insurance premium of 12.69 (USD), 40 persons (11.8%) were WTP, whereas 229 respondents (88.2%) refused the insurance due to its high price and limited coverage (i.e. cover on the loss of income cases only).

Table 3. WTP behaviour for flood insurance.

| Insurance premium | Frequency (No Pay) | Frequency (Pay) |
|--------------------|--------------------|-----------------|
| Insurance premium 19.04 (USD) | 318 | 21 |
| Condition: | | |
| 1) Compensation for lost income | | |
| 2) House repair expenses | | |
| % of WTP | 93.8% | 6.2% |
| Insurance premium 25.39 (USD) | 336 | 3 |
| Condition: | | |
| 1) Compensation for lost income | | |
| 2) House repair expenses | | |
3) Compensation for Third-party
% of WTP Insurance premium 12.69 (USD) Condition:
99.1% 299
0.9% 40
1) Compensation for lost Income
% of WTP
88.2% 11.8%
Source: calculated.

Table 4 displays the respondents’ income range and selected insurances. In the lowest insurance premium (19.04 USD), the largest portion of respondents (11 households/52.4%) made less than 158.66 to 477.61 (USD) per month, followed by 4 households (19%) receiving 158.66 to 477.61 (USD), 2 households (9.5%) received 318.44 to 477.61 (USD) and 1 household (4.8%) received 477.65 to 636.82 (USD). The second (25.39 USD) and third (12.69 USD) insurance premiums are shown in Table 4 (below).

| Income level (USD per month) | Insurance premium 19.04 (USD) | Insurance premium 25.39 (USD) | Insurance premium 12.69 (USD) | Total |
|------------------------------|--------------------------------|--------------------------------|--------------------------------|-------|
|                              | n | %    | n | %    | n | %    |
| Less than 11                 | 11 | 52.4 | 1 | 33.3 | 1 | 2.6  |
| 158.66 – 317.32              | 4  | 19.0 | 1 | 33.3 | 16| 41.0 |
| 318.44 - 477.61              | 2  | 9.5  | 1 | 33.3 | 20| 51.3 |
| 477.65 - 636.82              | 1  | 4.8  | 0 | 0    | 2 | 5.1  |
| 636.85 - 796.02              | 1  | 4.8  | 0 | 0    | 0 | 0    |
| 796.05 - 955.23              | 0  | 0    | 0 | 0    | 0 | 0    |
| 955.26 - 1,586.60            | 2  | 9.5  | 0 | 0    | 0 | 0    |
| More than 1,586.60           | 0  | 0    | 0 | 0    | 0 | 0    |
| Total                        | 21 | 100% | 3 | 100% | 39| 100% |
Source: calculated.

The results of the multiple linear regression analyses are shown in Table 5. The model was statistically significant (F = 6.10, p<0.001) with data having an adjusted $R^2$ of 0.23. The portion of the variance in WTP was significantly associated with insurance, height, and duration, respectively (all p<0.05). The results showed that insurance had a negative coefficient of -0.475 indicating that the cost of flood insurance was not likely to cause a change in the outcome of WTP. However, the height or level of the water inside the house (m) was found to have a significant positive coefficient (0.090, p<0.001), suggesting that water inside the house may moderately influence WTP flood insurance. Similarly, the duration or period of flooding in the house (days) had a positive coefficient (0.098, p=0.01), indicating that this factor may also moderately influence WTP flood insurance. However, gender, age, status, level of education (Edu), occupation (Occ), income, houseowner, number of households (Numh), houseprice, age of the house, Stairs, value of the damage, and loss of revenue, were all found to have low adjusted $R^2$ values (all p>0.05, Table 5) and therefore likely to be less significant factors in influencing WTP flood insurance.
The results of the multiple linear regression analysis are shown in Table 5. The results showed that McFadden $R^2$ was 0.402, whereas the Log-Likelihood ratio (LR) statistic was significant at one percent demonstrating that the respondents are not likely WTP flood insurance. House price ($1.913$, $p = 0.017$), damage ($0.966$, $p < 0.01$), flood height ($1.714$, $p = 0.013$) and duration ($1.542$, $p = 0.006$) all had a significant positive relationship with WTF flood insurance.

In considering the Odds ratio from the $\text{Exp}(B)$, a 1 unit increase in each variable would increase the odds of WTP flood insurance by the following: duration of house flooding (days) ($2.762$), damage ($2.685$), height ($2.478$), house price ($2.395$). In contrast, a 1 unit increase in stairs, would decrease the odds of WTP by $-1.894$, thus the number of floors does not affect WTP flood insurance.

The results of the binary logistic function analysis are shown in Table 6. The results showed that McFadden $R^2$ was 0.402, whereas the Log-Likelihood ratio (LR) statistic was significant at one percent demonstrating that the respondents are not likely WTP flood insurance. House price ($1.913$, $p = 0.017$), damage ($0.966$, $p < 0.01$), flood height ($1.714$, $p = 0.013$) and duration ($1.542$, $p = 0.006$) all had a significant positive relationship with WTF flood insurance. In considering the Odds ratio from the $\text{Exp}(B)$, a 1 unit increase in each variable would increase the odds of WTP flood insurance by the following: duration of house flooding (days) ($2.762$), damage ($2.685$), height ($2.478$), house price ($2.395$). In contrast, a 1 unit increase in stairs, would decrease the odds of WTP by $-1.894$, thus the number of floors does not affect WTP flood insurance.

Table 5. Results of the multiple linear regression analysis.

| Variable       | Coefficient | Std. Error | t-Statistic | p-values |
|----------------|-------------|------------|-------------|----------|
| Insurance      | -0.475      | 0.179      | -2.647      | 0.009**  |
| Gen            | 0.045       | 0.039      | 1.54        | 0.250    |
| Age            | 0.030       | 0.027      | 1.109       | 0.268    |
| Status         | 0.001       | 0.002      | 0.475       | 0.635    |
| Edu            | -0.027      | 0.035      | -0.774      | 0.440    |
| Occ            | -0.007      | 0.016      | -0.454      | 0.650    |
| Income         | 0.015       | 0.021      | 0.679       | 0.498    |
| House owner    | 0.010       | 0.019      | 0.552       | 0.581    |
| Numh           | 0.011       | 0.030      | 0.352       | 0.725    |
| House price    | 0.014       | 0.010      | 1.318       | 0.188    |
| Age House      | 0.052       | 0.030      | 1.721       | 0.086    |
| Stairs         | 0.002       | 0.002      | 1.172       | 0.242    |
| Damage         | -0.061      | 0.034      | -1.783      | 0.076    |
| Height         | 0.090       | 0.023      | 3.970       | 0.000**  |
| Duration       | 0.098       | 0.033      | 2.951       | 0.003**  |

Source: Calculated.
Note: * significant at level $p<0.01$; ** significant at level $p<0.05$; *** significant at level $p<0.10$.

Table 6. Logit regression results.

| Variable       | Coefficient | Std. Error | Exp (B) | p-values |
|----------------|-------------|------------|---------|----------|
| Insurance      | 0.075       | 0.710      | 0.105   | 0.916    |
| Gen            | 0.790       | 0.642      | 1.230   | 0.219    |
| Age            | 0.012       | 0.042      | 0.282   | 0.778    |
| Status         | -0.235      | 0.709      | -0.331  | 0.741    |
| Edu            | -0.205      | 0.367      | -0.560  | 0.576    |
| Occ            | 0.271       | 0.655      | 0.413   | 0.680    |
| Income         | 0.490       | 0.408      | 1.199   | 0.231    |
| House owner    | 0.626       | 0.799      | 0.783   | 0.434    |
| Numh           | 0.241       | 0.227      | 1.063   | 0.288    |
| House price    | 1.913       | 0.799      | 2.395   | 0.017**  |
| Age House      | 0.031       | 0.048      | 0.646   | 0.518    |
| Stairs         | -1.584      | 0.837      | -1.894  | 0.058**  |
| Damage         | 0.966       | 0.360      | 2.685   | 0.007**  |
| Height         | 1.714       | 0.692      | 2.478   | 0.013**  |
Duration &amp; 1.542 &amp; 0.558 &amp; 2.762 &amp; 0.006**
Log Likelihood = -44.665 &amp; McFadden R² = 0.402
Source: Calculated.
Note: * significant at level $p<0.01$; ** significant at level $p<0.05$; *** significant at level $p<0.10$.

5. Discussion and conclusions
This research examined respondents WTP flood insurance using the Phang Khon, Sakon Nakhon Province in Thailand as a case study. The multiple linear regression analysis showed that the main factors affecting WTP were insurance price, and the height and duration of flooding. In the present study, we also calculated the ML - Binary Logistic (Newton-Raphson/Marquardt steps) method to find factors affecting WTP, such as house price, stairs, damage and flood height and duration. The variables that were found to possibly have a relationship with WTP were Edu, Income, and House price. Our research also found that the level of education respondents, income per household, and house price in this area did not influence WTP insurance. When flooding occurred, the respondents tended not to understand or be aware of the importance of flood prevention and the serious consequences flooding can bring. In regards to the respondent’s behaviour towards WTP flood insurance, we found that most respondents (40 persons, 11.8%) were WTP a flood insurance premium of 12.69 USD. However, 299 respondents (88.2%) were not WTP, since the insurance was considered inexpensive with limited and unappealing coverage (i.e., compensation made on loss of income cases only). In contrast, an insurance premium of 19.04 (USD) was accepted by 21 persons (6.2%), while 318 persons (93.8%) had no WTP. An insurance premium of 25.39 (USD) was only accepted by 3 respondents (0.9%) while 336 persons (99.1%), mostly farmers, had no WTP insurance. Therefore, the data collected related to factors affecting WTP flood insurance can be used as a basic reference for relevant departments, such as insurance businesses and local government agencies, to provide a flexible approach towards risk assessments in flood risk areas in order to provide appropriate insurance programs. In future work, it may be possible to include more informative dimensions, as more information is needed to help people who experience flood disasters [17].

Acknowledgments
The research procedure, respondent consent forms, researchers, and questionnaires, were all approved by the Research Ethics Review Committee for Research Involving Human Subjects, Chulalongkorn University (COA No. 106/2563). The authors wish to acknowledge the support from all the respondents and the reviewers who significantly helped to improve the quality of this research.

References
[1] Office of the National Economic and Social Development Council 2017 Sakon Nakhon development plan 4 Year. Retrieved from: http://www.sakonnakhon.go.th/officeprovince/plan/plan/Document/
[2] Sakon Nakhon Disaster Prevention and Mitigation Plan 2015 revised version. Retrieved from:http://122.155.1.141/inner.snk:1.228/download/menu_4477/1136.1/?fbelcid=IwAR0iVII4suPBSTA2v0Qgj_d1B7N9BQxy2-omLk6QrLucDm3hF2zqgdG2-ig
[3] Nepal R 2015 Environmental Economics: An Introduction The Economic Record 91 272-4
[4] Roder G, Hudson P and Tarolli P 2019 Flood risk perceptions and the willingness to pay for flood insurance in the Veneto region of Italy Int. J. Disaster Risk Reduction 37 101172
[5] Isangkura A 1998 Environmental valuation: an entrance fee system for national parks in Thailand. EEPSEA research report series/IDRC Regional Office for Southeast and East Asia, Economy and Environment Program for Southeast Asia
[6] Sukharomana R 1999 Willingness to pay for water quality improvement: Differences between contingent valuation and averting expenditure methods (USA: University of Nebraska)
[7] Cohen M A, Rust R T, Steen S and Tidd ST 2004 Willingness-to-pay for crime control programs
Criminology 42 89-110

[8] Bunto J, Khongchan C, Bunboon S and Cheunchom N 2004 A Study of Factors Related to Payment of Wastewater Treatment Fee for the People in Khon Kaen Municipality Research and Training Journal Rajamangala Institute of Technology 8 72-8

[9] Wang X J, Zhang W, Li Y, Yang K Z and Bai M 2006 Air quality improvement estimation and assessment using contingent valuation method, a case study in Beijing Environ. Monit. Assess. 120 153-68

[10] Phumpraphat P and Akasing B 2008 Valuation of willingness to pay for Thung Talay Ling Kao Project, Sukhothai Province. Chiang Mai University Journal of Economics 12 74-91

[11] Sriprasong S 2010 WTP for and factor determination of Flood-Prevention Tax in Bangkok by Pasak Jolasid Dam (Thailand, Kasetsart University)

[12] Kittinathaphong N 2012 An Analysis of WTP for Improvement of Air Quality in the Pollution Control Area of Rayong Province Sukhothai Thammathirat Journal of Economics 6 1-18

[13] Nawasod A and Pattanarangsan P 2017 A Study of Willingness to Pay for Air Pollution Prevention for the Surrounding Ports and Laem Chabang Industrial Estate, Chon Buri Province Economics and Public Policy Journal 8 32-55

[14] Theerawattanakul P 2017 Estimation of willingness to pay for air quality improvement in Bangkok by contingent valuation method CVM: (A case study of Chatuchak Distric) (Thailand: Thammasat University)

[15] Srinark S, Praneetvatakul S and Pongput K 2018 Willingness to Pay for Sponge City Project Initiatives in Bangkok (No. 2193-2019-711)

[16] Yamane T, Tsuchimoto T and Yoshikawa H 2004 Simple, rapid and simultaneous determination of lead and cadmium in river water and soil samples with a flow-injection system utilizing in-line cation exchange separation and photometric detection Bunseki Kagaku 53 297-302

[17] Leelawat N, Muhari A, Srivichai M, Suppasri A, Imamura F and Bricker J D 2018 Preference for information during flood disasters: A study of Thailand and Indonesia Sustainable Future for Human Security ed B McLellan (Singapore: Springer) pp 335-49