

## **CHAPTER IV**

### **RESULTS**

The valuation of the willingness to pay for reducing the impacts of a sea level rise for a case study of Bang Khun sai sub-district in Phetchaburi province was conducted to collect field data from February 2014 to February 2015 by interviewing 380 locals of Bang Khun sai sub-district whose ages were 18-75 years old. The 380 interviewees were divided into two groups: the locals who live in the upland area for 159 people and those who live in the lowland area for 221 people. In addition, 9 in-depth interviewees were conducted to provide the information about the management plan and the guidelines to handle a sea level rise problem. The research results was divided into 6 parts as follows: (1) the economic-social characteristics of respondents, (2) the attitude of the respondents toward the country problem and comprehension of a sea level rise situation, (3) the optimal choice experiment model for this research, (4) the value of the willingness to pay, (5) the factors that influenced the willingness to pay, and (6) the guidelines for coping with the sea level rise situation; the results will be explained as follows:

#### **4.1 The economic-social characteristics of respondents**

From the results of this research, a ratio between male and female respondents were similar and most of them were married. The respondents were 48.7 years old in average. A number of years educated were 6.61 years in average. A number of years living in Bang Khun Sai sub-district were 41.86 years in average. A number of family members in each household were 4.72 persons with an average income of 9,763.2 Baht/person/month. Most respondents (52.1%) occupied in others occupations including general employees (excluding salt carrying), trading, coastal fishery (excluding pedal board clams), business owners, governmental officers, taking education etc., followed by salt farm owners and salt carrying (15.3%), pedal board

clams (13.9%), aquaculture (9.5%), and agriculture (9.2%) respectively. The majority of the respondents (81.1%) did not participate in any environmental groups or organizations.

When considering the respondents who lived in the upland area, it was found that the majority of the respondents were male and married with an average age of 50.13 years old. A number of years educated were 6.63 years. A number of years living in Bang Khun Sai sub-district were 43.13 years in average. A number of family members in each household were 4.56 persons with an average income of 10,880.5 Baht/person/month. Most respondents who lived in the upland area (35.8%) occupied in others occupations such as general employees (excluding salt carrying), trading, coastal fishery (excluding pedal board clams), business owners, governmental officers, taking education etc., followed by salt farm owners and salt carrying (25.2%), agriculture (21.4%), aquaculture (17%), and pedal board clams (0.6%), respectively. Additionally, it was found that 84.3% of the respondents who lived in the upland area did not participate in any environmental groups.

When considering the respondents who lived in the lowland area, it was found that the majority of the respondents were female and married with an average age of 47.74 years old. A number of years educated were 6.60 years. A number of years living in Bang Khun Sai sub-district were 40.94 years in average. A number of family members in each household were 4.83 persons with an average income of 8,959.3 Baht/person/month. Most respondents who lived in the lowland area (63.8%) occupied in others occupations such as general employees (excluding salt carrying), trading, coastal fishery (excluding pedal board clams), business owners, governmental officers, taking education etc., followed by pedal board clams (23.5%), salt farm owners and salt carrying (8.1%), aquaculture (4.1%), agriculture (0.5%), respectively. Additionally, it was found that 78.7% of the respondents who lived in the lowland area did not participate in any environmental groups. All details of respondents were shown in Table 4.1.

**Table 4.1** The economic-social characteristics of respondents

List of characteristics	Bang Khun Sai sub-district		Upland area		Lowland area	
	%	Average	%	Average	%	Average
<b>Genders</b>						
Male (substituted by 0)	49.5	0.51	55.3	0.45	45.2	0.55
Female (substituted by 1)	50.5		44.7		54.8	
<b>Ages (years)</b>						
18-40	28.4		23.9		31.7	
41-60	49.7	48.74	54.7	50.13	46.2	47.74
61-75	21.8		21.4		22.2	
<b>Marital statuses</b>						
Single/Divorce (substituted by 0)	22.1	0.78	20.8	0.79	23.1	0.77
Married (substituted by 1)	77.9		79.2		76.9	
<b>The number of years of education (years)</b>						
0-4	47.1		44.7		48.9	
5-7	20.5	6.61	25.2	6.63	17.2	6.60
over 8 years	32.4		30.2		33.9	
<b>The number of years living in Bang Khun sai (years)</b>						
0-30	30.5	41.86	25.8	43.13	33.9	40.94
over 31 years	69.5		74.2		66.1	
<b>The number of household members (persons)</b>						
1-4	52.1	4.72	56.6	4.56	48.9	4.83
Over 5 persons	47.9		43.4		51.1	
<b>Occupation</b>						
Pedal board clams	13.9	-	0.6	-	23.5	-
Aquaculture	9.5		17.0		4.1	

**Table 4.1** The economic-social characteristics of respondents (cont.)

List of characteristics	Bang Khun Sai sub-district		Upland area		Lowland area	
	%	Average	%	Average	%	Average
Salt farm owners and salt carrying	15.3		25.2		8.1	
Agriculture	9.2	-	21.4	-	0.5	-
Others such as general employees, trading, etc.	52.1		35.8		63.8	
Income (Baht/person/month)						
0-10,000	73.2		67.9		76.9	
10,001-50,000	26.8	9,763.2	32.1	10,880.5	23.1	8,959.3
Being a member of the environmental organization						
Member (substituted by 0)	81.1		84.3		78.7	
Non-member (substituted by 0)	18.9	0.19	15.7	0.16	21.3	0.21

#### 4.2 The attitude of the respondents toward the country problem and comprehension of a sea level rise situation

The questions in this part were used to assess the attitude of respondents about the major problems of Thailand that needs to be taken care of. Based on Table 4.2, it can be seen that most respondents agreed that the government should allocate the budget for decreasing the level of poverty the most (43.4% of the respondents); subsequently, 22.9% of the respondents wanted the government to promote the natural resources conservation; 15.8 % of the respondents wanted the government to improve the quality of education system, respectively.

**Table 4.2** Attitude toward the major problems of Thailand that need to be solved by the government

<b>Major problems of Thailand that needed to be solved</b>	<b>number of people</b>	<b>%</b>	<b>Rank</b>
Decreasing the level of poverty	165	43.4	1
Reduction of the pollution	17	4.5	5
Natural resources conservation	87	22.9	2
Handle the climate change situation and the global warming	15	3.9	6
Improve the quality of education system	60	15.8	3
Others such as economic and politic, narcotic, infrastructure, quality of life, assisting handicapped, the usages of chemicals in agriculture, no problem at all, etc.	36	9.5	4
<b>Total</b>	<b>380</b>	<b>100.0</b>	<b>-</b>

In terms of the concerns about the impacts of climate change, most respondents were worried about the impacts on drought as the first priority (39.1% of the respondents). The rest of respondents (12.9%) concerned equally about the reduction of the agriculture product, the epidemic diseases, and the sea level rise situation. Additionally, about 12.7% of the respondents concerned about the impacts of flooding. Table 4.3 showed the details regarding the respondents' concern about the impacts of climate change.

To assess the respondents' attitude, the respondents must answer to those 9 passages by expressing their opinions for absolutely disagree, disagree, no comment, agree, and absolutely agree. In general, 380 respondents had good attitude toward the responsibility in solving natural resources and environmental problems (attitude degree of medium-maximum level). The details can be explained as follows:

**Table 4.3** Concerns about the impacts of climate change

<b>The impacts of climate change</b>	<b>number of people</b>	<b>%</b>	<b>Rank</b>
Reduction of agriculture products	49	12.9	2
Drought	148	39.1	1
Flooding	48	12.7	5
Epidemic diseases	49	12.9	2
The sea level rise	49	12.9	2
Others such as a decrease of fishery products, a diminution of income, a change of seasons, no concern at all, etc.	36	9.5	6
Missing	1	-	
<b>Total</b>	<b>380</b>	<b>100.0</b>	<b>-</b>

**The passage with the maximum level of attitude** of which the average score range was 3.21-4.00 scores i.e., Passage (2) “*We should protect any damages that may occur to the natural resources so the next generation can utilize from those natural resources*” which means the non-use value but to maintain it for the next generation (Bequest value). It was found that about 53.3% of the respondents agree and 43.5% absolutely agree with this passage. This indicates that protecting natural resources in present will yield some benefits to the next generation. The average score was 3.40.

Passage (3) “*The coastal wetlands areas such as mangrove forest, mudflat should receive some protection from the threatens from both nature and human being due to those areas are the economically important aquatic nursery*” which means the use value kind the direct utilization (Direct use value) such as pedal board clams, coastal fishery, cutting the wood in the mangrove forests to be used as some fuel logs, etc. It was found that 50.3% of the respondents absolutely agree, 48.4% agree with this passage. The average score was 3.49.

**The passage with the high level of attitude** of which the average score range was 2.41-3.20 scores i.e., Passage (1) “*The government should increase a budget for operating or planning about Thailand environment.*” It was found that most respondents (72.0%) agree with this passage. The average score was 3.10.

Passage (4) “*Every Thai people including yourself should be responsible for donating money to prevent the impacts on the natural resources even though we do not receive any benefit from such resources*”, which means the non-use value kind the aware of the natural resources existence though they may not have an opportunity to utilize them (Existence value). It was found that most respondents (66.3%) agree with this passage. The average score was 2.94.

Passage (5) “*Although you do not utilize or receive any benefits from the mangrove forest or the mudflat, you still ready to pay some money for protecting the mangrove forest or the mudflat because you may utilize them in the future*”, which means the non-use value kind the people have not yet utilized the natural resources at the present but expect to utilize them in the future (Option use value) as in a type of paying some money to conserve or preserve the habitat for aquatic animals, the biodiversity, the natural beauty. It was found that most respondents (68.4%) agree with protecting the natural resources for the future or next generation. The average score was 3.07.

Passage (6) “*The money expenditure for protecting the mangrove forest is worthwhile due to the mangrove forests help in protection of the coastal erosion and protection of the agriculture products from saltwater invasion*”, which means the use value kind the indirect utilization (Indirect use value). It was found that most respondents (66.3%) agree with this passage. The average score was 3.19.

Passage (8) “*The government should increase the income tax of people with high salary to use it for dealing with the impacts of climate change*” It was found that half of the respondents (51.5%) agree with this passage. The average score was 3.06.

Passage (9) “*There should be some plans or guidelines to handle the impacts of climate change in each area*” It was found that most respondents (66.8%) agree with the passage. The average score was 3.17.

**The passage with the medium level of attitude** of which the average score range was 1.61-2.40 scores i.e., Passage (7) “The government should increase the income tax in order to use it for dealing with the impacts of climate change.” It was found that 35.4% of the respondents agree with this passage; however, there was about 34.1% disagree with this passage. The average score was 1.93 as shown in Table 4.4.

**Table 4.4** The respondents’ attitude toward the responsibility in solving the natural resources and environmental problems

Passage/Meaning	Percentage					Average
	0	1	2	3	4	
(1) The government should increase a budget for operating or planning about Thailand environment/ Environmental policy	0	2.6	5.0	72.0	20.3	3.10
(2) We should protect any damages that may occur to the natural resources so the next generation can utilize from those natural resources/ Bequest value	0	0.8	2.4	53.3	43.5	3.40
(3) The coastal wetlands areas such as mangrove forest, mudflat should receive some protection from the threatens from both nature and human being due to those areas are the economically important aquatic nursery/ Direct use value	0	0.3	1.1	48.4	50.3	3.49
(4) Every Thai people including yourself should be responsible for donating money to prevent the	0.8	7.9	6.6	66.3	18.4	2.94

**Table 4.4** The respondents' attitude toward the responsibility in solving the natural resources and environmental problems (cont.)

Passage/Meaning	Percentage					Average
	0	1	2	3	4	
impacts on the natural resources even though we do not receive any benefit from such resources/ Existence value						
(5) Although you do not utilize or receive any benefits from the mangrove forest or the mudflat, you still ready to pay some money for protecting the mangrove forest and the mudflat because you may utilize them in the future/ Option use value	0.5	5.5	2.9	68.4	22.6	3.07
(6) The money expenditure for protecting the mangrove forest is worthwhile due to the mangrove forests help in protection of the coastal erosion and protection of the agriculture products from saltwater invasion/ Indirect use value	0.3	3.2	2.1	66.3	28.2	3.19
(7) The government should increase the income tax in order to use it for dealing with the impacts of climate change/ Environmental policy	10.8	34.1	13.0	35.4	6.6	1.93
(8) The government should increase the income tax of people with high salary to use it for dealing with the	1.3	7.1	7.9	51.5	32.2	3.06

**Table 4.4** The respondents’ attitude toward the responsibility in solving the natural resources and environmental problems (cont.)

Passage/Meaning	Percentage					Average
	0	1	2	3	4	
impacts of climate change/ Environmental policy						
(9) There should be some plans or guidelines to handle the impacts of climate change in each area/ Environmental policy	0	1.6	5.5	66.8	26.1	3.17

Note: 0 meaning absolutely disagree  
 1 meaning disagree  
 2 meaning no comment  
 3 meaning agree  
 4 meaning absolutely agree

For the part of awareness of a sea level rise situation, most respondents (89.7%) know that we are facing climate change situation; 69.2% of the respondents knows that climate change causes the sea level rise. Additionally, during the interview, the researcher used information cards explaining to the respondents (see Appendix C), after that it showed that almost half of the respondents in Bang Khun Sai sub-district (48.7%) understand about sea level rise and potential impacts. The score range from 0-4 level was applied in this process, which showed that the level of understanding of the respondents was at 2.59. When considering by areas, the respondents who lived in the upland area and lowland area had a level of understanding at 2.61 and 2.58 respectively. As shown in Table 4.5.

**Table 4.5** The level of understanding of the respondents about sea level rise and potential impacts

Level of understanding	Bang Khun Sai sub-district		Upland area		Lowland area	
	%	Average	%	Average	%	Average
Absolutely not understand (substituted by 0)	0.8		1.9		0	
Not understand (substituted by 1)	8.2		7.5		8.6	
Somewhat understand (substituted by 2)	32.1	2.59	29.6	2.61	33.9	2.58
Understand (substituted by 3)	48.7		49.7		48.0	
Thoroughly understand (substituted by 4)	10.3		11.3		9.5	

### 4.3 The optimal choice experiment model for this research

The valuation of the willingness to pay for reducing the impacts of a sea level rise of the locals in Bang Khun sai sub-district was done by applying choice experiment technique which specified the respondents to choose from various choices that can decrease such impacts and to compare with the no action option. In this valuation, the coefficients of the money attribute variable and other attribute variables at different levels for decreasing the impacts of a sea level rise obtained from the optimal choice experiment model were used in the calculation.

For the analysis of the factors that affect the willingness to pay, the coefficients of the money attribute variables, the economic-social characteristics of respondents variables, including the variables of comprehension of the problems acquired from the optimal choice experiment model were used in the calculation and the interpretation.

The money attribute variables were the amount of money supporting the fund (COST) and the amount of money supporting the fund divided by the average income (COSTi).

The attribute variables at different levels for reducing the impacts of a sea level rise were as follows: the reduction of the loss of income from pedal board clams at the excellent level (INPCe), the reduction of the loss of income from pedal board clams at the good level (INPCg), the reduction of the loss of income from aquaculture at the excellent level (INAQe), the reduction of the loss of income from aquaculture at the good level (INAQg), the reduction of the loss of income from salt farming at the excellent level (INSFe), the reduction of the loss of income from salt farming at the good level (INSFg), the reduction of the loss of income from agriculture at the excellent level (INAGe), the reduction of the loss of income from agriculture at the good level (INAGg), the reduction of the frequency and the duration of flooding at the excellent level (FLOODe), the reduction of the frequency and the duration of flooding at the good level (FLOODg), the reduction of the loss of the mangrove forests and the mudflat areas at the excellent level (MAMUe), and the reduction of the loss of the mangrove forests and the mudflat areas at the good level (MAMUg).

The economic-social characteristics of respondents variables were assigned to be the dummy variables as follows: the upland area (Upland), the lowland area (Lowland), male gender (Male), female gender (Female), ages between 18-40 years old (Agelow), ages between 41-60 years old (Agedmed), ages between 61-75 years old (Agehigh), being single/divorce (Single), being married (Marriage), the number of years of education for 0-4 years (Nedulow), the number of years of education for 5-7 years (Nedumed), the number of years of education for over 8 years (Neduhigh), the number of years living in Bang Khun sai for 0-30 years (Treslow), the number of years living in Bang Khun sai for over 31 years (Treshigh), the number of household members for 1-4 persons (Hnumlow), the number of household members for over 5 persons (Hnumhigh), the occupation as pedal board clams (Pc), the occupation as aquaculture (Aq), the occupation as salt farm owners and salt carrying (Sf), the occupation as agriculture (Ag), other occupation such as general employees, trading, etc.(Ot), the income of 0-10,000 Baht/person/month (Iinclow), the average income of 10,001-50,000 Baht/person/month (Iinchigh), being non-member of the

environmental organization (Notenviorg), and being a member of the environmental organization (Enviorg).

The variables of comprehension of the problems including the sea level rise situation and potential impacts were assigned to be the dummy variables as follows: absolutely not understand/not understand (Undlow), somewhat understand (Undmed), and understand/thoroughly understand (Undhigh).

All 380 respondents was given three choice sets each, thus there were 1,140 observations to be analyzed. The coefficients calculated from choice experiment models or the parameter estimates from conditional logit models were shown in Table 4.6. The choice experiment models print out from the statistical program were showed in Appendix E.

**Table 4.6** Parameter estimates from conditional logit models

<b>Variable</b>	<b>Model 1 Coefficient (P-value)</b>	<b>Model 2 Coefficient (P-value)</b>	<b>Model 3 Coefficient (P-value)</b>
<b>Money attributes</b>			
COST	-0.000597** (0.0146)	-0.000705*** (0.0069)	-0.000684*** (0.0094)
COSTi	-7.964231*** (0.0000)	-7.354728*** (0.0000)	-7.471320*** (0.0000)
<b>Attributes at different levels for reducing the impacts of sea level rise</b>			
INPCe	0.1321** (0.0210)	0.1248** (0.0300)	0.1296** (0.0238)
INPCg	-0.0462 (0.4389)	-0.0440 (0.4659)	-0.0559 (0.3502)
INAQe	0.0396 (0.4931)	0.0511 (0.3818)	0.0458 (0.4176)

**Table 4.6** Parameter estimates from conditional logit models (cont.)

Variable	Model 1	Model 2	Model 3
	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)
INAQg	0.0926 (0.1124)	0.0860 (0.1430)	-
INAQg * Nedu	-	-	0.014447** (0.0458)
INSFe	-0.0098 (0.8668)	-0.0125 (0.8314)	0.0020 (0.9706)
INSFg	-0.0138 (0.8121)	-0.0164 (0.7791)	-
INSFg * Iinc	-	-	-0.00000409 (0.2778)
INAGe	0.0263 (0.6575)	0.0244 (0.6827)	-
INAGe * Iinc	-	-	-0.00000396 (0.3638)
INAGg	-0.0493 (0.3981)	-0.0546 (0.3529)	-
INAGg * Iinc	-	-	-0.00000367 (0.3882)
FLOODe	0.1503** (0.0111)	0.1478** (0.0133)	-
FLOODe * Iinc	-	-	0.00000825** (0.0308)
FLOODg	-0.0248 (0.6689)	-0.0182 (0.7548)	0.0159 (0.7685)
MAMUe	0.2757*** (0.0000)	0.2683*** (0.0000)	0.2960*** (0.0000)

**Table 4.6** Parameter estimates from conditional logit models (cont.)

Variable	Model 1	Model 2	Model 3
	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)
MAMUg	0.0396 (0.4910)	0.0423 (0.4657)	-
MAMUg * Iinc	-	-	-0.00000025 (0.9489)
<b>Economic-social characteristics of respondents</b>			
Upland	-	0.5031*** (0.0095)	0.5002*** (0.0097)
Nedumed	-	0.7024*** (0.0013)	0.6643*** (0.0024)
Neduhigh	-	0.8395*** (0.0000)	0.7302*** (0.0005)
Pc	-	0.3472 (0.1492)	0.3568 (0.1386)
Aq	-	-0.0698 (0.8166)	-0.0686 (0.8193)
Sf	-	-0.4555* (0.0528)	-0.4534* (0.0536)
Ag	-	-0.2936 (0.3506)	-0.2954 (0.3459)
Treshigh	-	0.1769 (0.3396)	0.1904 (0.3033)
Iinchigh	-	-0.2737 (0.1734)	-0.2360 (0.2851)
Enviorg	-	0.0719 (0.7361)	0.0616 (0.7730)

**Table 4.6** Parameter estimates from conditional logit models (cont.)

Variable	Model 1	Model 2	Model 3
	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)
<b>Comprehension of the problems</b>			
Undmed	-	0.9672*** (0.0001)	0.9695*** (0.0001)
Undhigh	-	1.4303*** (0.0000)	1.4377*** (0.0000)
Log-likelihood function	-1,069.648	-1,033.135	-1,032.037
No. of respondents	380	380	380
No. of observations	1,140	1,140	1,140
Note:	*** meaning being statistically significant at the 99% confidence level		
	** meaning being statistically significant at the 95% confidence level		
	* meaning being statistically significant at the 90% confidence level		

Model 1 only considered the money attribute variables and the attribute variables at different levels for reducing the impacts of sea level rise. Based on the assumption that the economic-social characteristics of respondents variables as well as the variables of comprehension of the problems had no influence on making a choice decision, it was found that the log-likelihood function was approximately -1,069.648. In addition, there were three attribute variables for reducing the impacts of sea level rise being statistically significant as follows: the reduction of the loss of income from pedal board clams at the excellent level, the reduction of the frequency and the duration of flooding at the excellent level, and the reduction of the loss of the mangrove forests and the mudflat areas at the excellent level.

Model 2 considered all the money attribute variables, the attribute variables at different levels for reducing the impacts of sea level rise, the economic-social characteristics of respondents variables, and the variables of comprehension of the problems. Based on the assumption that the money attribute variables, the

economic-social characteristics of respondents variables, and the variables of comprehension of the problems had influence on making a choice decision, it was found that the log-likelihood function was about -1,033.135. Furthermore, there were three attribute variables for reducing the impacts of the sea level rise being statistically significant as follows: the reduction of the loss of income from pedal board clams at the excellent level, the reduction of the frequency and the duration of flooding at the excellent level, and the reduction of the loss of the mangrove forests and the mudflat areas at the excellent level.

Model 3 considered all the money attribute variables, the attribute variables at different levels for reducing the impacts of sea level rise, the economic-social characteristics of respondents variables, and the variables of comprehension of the problems. Beside based on the assumption that the money attribute variables, the economic-social characteristics of respondents variables, and the variables of comprehension of the problems had influence on making a choice decision, the interaction were created between the average of some economic-social characteristics of respondents variables and some attribute variables at different levels for reducing the impacts of sea level rise; it was found that the log-likelihood function was around -1,032.037. Additionally, there were four attribute variables for reducing the impacts of sea level rise being statistically significant as follows: the reduction of the loss of income from pedal board clams at the excellent level, the reduction of the loss of income from aquaculture at the good level, the reduction of the frequency and the duration of flooding at the excellent level, and the reduction of the loss of the mangrove forests and the mudflat areas at the excellent level.

By comparing all three models, it was indicated that the optimal choice experiment model was the model 3 because its model error was the lowest by considering the log-likelihood function was the least negative number. Moreover, there were four attribute variables for reducing the impacts of sea level rise being statistically significant, while the other models had three attribute variables that statistically significant.

As a result, model 3 was used in this research to valuate the willingness to pay and the influenced factors; the model also provided the interaction between the average of economic-social characteristics of respondents variables i.e., the average of

the number of years of education was 6.6 years, and the average income was 9,763.2 Baht/person/month with some attribute variables at different levels for decreasing the impacts of a sea level rise. Hence, some coefficients were converted according to the average of the economic-social characteristics of respondents variables that create the interaction as shown in Table 4.7. Only statistically significant variables were shown. It should be noted that the attribute variables for reducing the loss of income from salt farming and agriculture were not statistically significant.

**Table 4.7** Coefficients conversion of the statistically significant variables based on the results from optimal choice experiment model

<b>Variable</b>	<b>Coefficient pre-conversion</b>	<b>The average of the economic-social characteristics of respondents variables used in creating the interaction variables</b>	<b>Coefficient post-conversion</b>
<b>Money attributes</b>			
Cost	-0.000684	-	-
Costi	-7.471320	-	-
<b>Attributes at different levels for reducing the impacts of sea level rise</b>			
INPCe	0.1296		
INAQg	0.014447	6.6	0.0954
FLOODE	0.00000825	9,763.2	0.0805
MAMUe	0.2960		
<b>Economic-social characteristics of respondents</b>			
Upland	0.5002	-	-
Nedumed	0.6643	-	-
Neduhigh	0.7302	-	-
Sf	-0.4534	-	-
<b>Comprehension of the problems</b>			
Undmed	0.9695	-	-
Undhigh	1.4377	-	-

#### 4.4 The value of the willingness to pay

Calculation of value of the willingness to pay for reducing the impacts of a sea level rise from one level to another level in the same attribute by using the estimated results from the optimal choice experiment model and considering only the money attribute variables and the statistically significant attribute variables at different levels in reducing the impacts of sea level rise (as shown in Table 4.7), can be determined from Equation 4.1:

$$WTP = CS = -\frac{1}{\beta_C + \frac{\beta_{CI}}{I}}(V_{i1} - V_{i0}) \quad (4.1)$$

where  $V_{i0}$  is the utility of the attribute for reducing the impacts of a sea level rise at the level of no action taken, meaning the coefficient of such attribute needs to be multiplied by -1 according to the effect coding of the attribute,

$V_{i1}$  is the utility of the attribute for reducing the impacts of a sea level rise at either the good level or the excellent level, meaning the coefficient of such attribute needs to be multiplied by 1 according to the effect coding of the attribute,

$V_{i1} - V_{i0}$  is the indirect utility that is increased from the level of no action taken to either the good level or the excellent level,

$\beta_C$  is the coefficient of the money attribute contributing to the fund that equals -0.000684,

$\beta_{CI}$  is the coefficient of the money attribute contributing to the fund divided by the average income that equals 7.471320,

$I$  is the average income that equals 9,763.2 Baht/person/month.

According to calculation, it was found that the locals of Bang Khun Sai had the willingness to pay (WTP) as follows: the WTP at the excellent level to decrease the loss of income from pedal board clams for about 179 Baht/person/year, the WTP at the good level to reduce the loss of income from aquaculture around 132 Baht /person/year, the WTP at the excellent level to decrease the frequency and the duration of flooding about 111 Baht/person/year, and the WTP at the excellent level to decrease the loss of the mangrove forests and the mudflat areas around 408 Baht

/person/year. As a result, the total value of the willingness to pay of the locals in Bang Khun Sai for reducing the impacts of sea level rise was equal to  $179+132+111+408 = 830$  Baht/ person/year as shown in Table 4.8. If we took that value multiplied by the number of population in Bang Khun Sai 6,977 people, then the total value of the willingness to pay for reducing the impacts of sea level rise of the whole sub-district of Bang Khun Sai would be about 5,790,910 Baht/year.

**Table 4.8** The value of the willingness to pay (WTP) for reducing the impacts of a sea level rise

Attribute	$V_{i0}$	$V_{i1}$	$V_{i1} - V_{i0}$	WTP
The reduction of the loss of income from pedal board clams at the excellent level	0.1296(-1)	0.1296(1)	0.2592	179
The reduction of the loss of income from aquaculture at the good level	0.0954(-1)	0.0954(1)	0.1908	132
The reduction of the frequency and the duration of flooding at the excellent level	0.0805(-1)	0.0805(1)	0.1610	111
The reduction of the loss of the mangrove forests and the mudflat areas at the excellent level	0.2960(-1)	0.2960(1)	0.5920	408
<b>Total</b>				<b>830</b>

However, there were some respondents that were not willing to pay for reducing the impacts of sea level rise (about 15.8% of the respondents). Their reasons were as follows: (1) they were not able to pay due to their low income, (2) they thought that it should be the responsibility of the government, (3) they were not too sure that the money contribution will be really used for solving the problem of a sea level rise, and (4) they were not too sure about successfully operating plan, respectively.

On the other hand, most of the respondents (84.2%) were willing to pay for reducing the impacts of a sea level rise. In addition, 80.90% of respondents that willing to pay thought that the main authority who should be mainly responsible for this fundraising was the local authority i.e., Bang Khun sai Subdistrict Administrative Organization. Whereas, some of the respondents thought that it should be the role of the community leaders such as the village chief, the sub-district chief, or other government authorities for example the Provincial Offices for Natural Resources and Environment, the Natural Resources and Environmental Protection Volunteer, or the local conservation group such as the Bang Khun Sai Subdistrict Marine Resource Conservation Group, or there should be appointing the management committee for managing the fund, and Bang Khun Sai locals should be representatives in this committee.

#### **4.5 The factors that influenced the willingness to pay**

These factors can be considered from the money attribute variables supporting to the fund, the statistically significant variables from the optimum choice model (as displayed in Table 4.7) of the economic-social characteristics of respondents, and the comprehension of the problems. The signs in front of the coefficient of the variables indicate the directions of the relationships on how it influence on making a decision. If the sign was a plus (+), it means there is a relationship going in the same direction. However, if the sign was a minus (-), it means there is a relationship going in the opposite direction. In addition, the relationship between the dummy variables can be expressed by calculating the marginal willingness to pay from Equation 4.2:

$$MWTP = IP = \frac{-\beta_d}{\beta_c + \frac{\beta_{cl}}{I}} \quad (4.2)$$

where  $\beta_d$  is the coefficient of the dummy variables.

In this research, such factors were divided into three parts: the amount of money contributing to the fund, the economic-social characteristics of respondents, and the comprehension of the problems which can be explained as follows:

(1) The amount of money contributing to the fund

The coefficient of the money contributing to the fund variable (COST) was equal to -0.000684 and was statistically significant at the confidence level of 99%. The minus (-) sign indicated that such variable had the opposite direction relation to the willingness to pay, which means that if the requested amount of money contributing to the fund is high, the willingness to pay will decrease.

(2) The economic-social characteristics of respondents

The economic-social characteristics of respondents factors that influence the willingness to pay are as follows:

- Physical features of dwelling areas. The coefficient of the upland area variable (Upland) was equal to (+)0.5002 and statistically significant at the confidence level of 99%. The plus (+) sign indicated that such variable had the same direction relation to the willingness to pay, which means that the respondents who live in the upland area were willing to pay more than the ones who live in the lowland area for about 345 Baht.

- The number of years of education. The coefficients of the number of years of education variables for 5-7 years (Nedumed) and for over 8 years (Neduhigh) were equal to (+)0.6643 and (+)0.7302, respectively. They were statistically significant at the confidence level of 99%. The plus (+) sign indicated that such variables had the same direction relation to the willingness to pay, which means that the respondents whose years of education were 5-7 years had more willingness to pay than those of 0-4 years about 458 Baht. Also, the respondents whose years of education were more than 8 years had more willingness to pay than those of 5-7 years about 45 Baht.

- Occupation. The coefficient of the occupation variable for salt farm owners and salt carrying (Sf) was equal to (-)0.4534 and statistically significant at the confidence level of 90%. The minus (-) sign indicated that such variable had the opposite direction relationship to the willingness to pay, which means that the

respondents whose jobs were salt farm owners and salt carrying had less willingness to pay than other respondents who did other work for about 313 Baht.

(3) The comprehension of the problems

The comprehension of the problems including a sea level rise situation and potential impacts. The coefficients of the somewhat understand variable (Undmed) and the understand/thoroughly understand variable (Undhigh) were equal to (+)0.9695 and (+)1.4377 respectively. They were statistically significant at the confidence level of 99%. The plus (+) sign indicated that such variables had the same direction relation to the willingness to pay, which means that the respondents who somewhat understand the problems had more willingness to pay than those who absolutely not understand/not understand for about 669 Baht; the respondents who understand/thoroughly understand had more willingness to pay more than those who somewhat understand for about 323 Baht.

#### **4.6 The guidelines for coping with a sea level rise situation**

Based on the in-depth interviews, the guidelines or the methods for dealing with a sea level rise were obtained. The 9 interviewees were divided into: 3 official authorities who are responsible for natural resources and environmental management, 2 official authorities who are responsible for monitoring and planning the vocational plan, 1 local authority that is responsible for oversee the areas directly, and 3 local experts. This research result presented the current plan or procedures as well as the future plans and guidelines to properly handle a sea level rise situation in Bang Khun sai sub-district.

Data were classified and used as the theme in the thematic analysis. It was found that at present there is no plan or measure available in any organizations to deal with a sea level rise situation in Bang Khun sai sub-district. However, there are some authorities that are aware of the climate change, so they *have the plan for dealing with climate change though the framework still unclear*. (In-depth interviewee code 01)

Although Bang Khun sai sub-district has no plan to deal with a sea level rise, there still are some operating government projects that can decrease the impact of a sea level rise, which are hidden in some other projects such as the saltwater barrier

road No.1 construction project, the improvement of the drainage system project, the zoning of land use project, etc. as well as some cooperation projects between the government sector and the locals for example the mangrove forest conservation project, the saltwater levee construction project, the freshwater expelling the saltwater project, etc.

The current operating project that was most repetitively answered by the interviewees was the conservation of the mangrove forest project, which has a variety of operating methods including protection of trespass, appropriately afforestation, creating awareness of having the mangrove forest and generating networks for marine natural resources conservation. In addition, the physical features of the coastal area are stable meaning the erosion of the coast and the deposition rates are almost equal or equal, so the mangrove forest areas in Ban Khun Sai have been increased from the past. Subsequently, for other projects that the interviewees repetitively answered were the saltwater barrier road No.1 construction project which can protect the saltwater invasion to the inner land, and the zoning of land use project which divided the areas into saltwater area and freshwater area. It should be noted that, the in-depth interviewees agreed that by operating this projects, some problems have occurred due to there are some people lose their benefits. So it is difficult to use the zoning of land use in practice and make it effective. The details were shown in Table 4.9.

**Table 4.9** Current operating projects to handle a sea level rise situation in Bang Khun Sai sub-district

<b>Current operating projects</b>	<b>Details</b>	<b>Interviewees (persons)/ Code</b>
Projects to handle a sea level rise	- Current operating projects to handle a sea level rise situation in Bang Khun sai sub-district.	-
The saltwater barrier road No.1	- The saltwater barrier road No.1 construction to protect the impacts of a sea level rise and saltwater invasion in agricultural area.	3/ 03, 07, 09

**Table 4.9** Current operating projects to handle a sea level rise situation in Bang Khun Sai sub-district (cont.)

<b>Current operating projects</b>	<b>Details</b>	<b>Interviewees (persons)/ Code</b>
The saltwater levee	- The saltwater levee in the onshore area to solve the issue of the infiltration of saltwater into the freshwater area. There are two main saltwater levees in Bang Khun Sai: 1) the saltwater levee at Moo 6 which obstructs between saltwater and brackish water and at Moo 7 which obstructs brackish water and freshwater and 2) the sandbags levee at Moo 4 to protect saltwater invasion. The levees receive mutual maintenance from the government sector organization, the local authorities, and nearby sub-districts. Also, there is some fundraising from Bang Khun Sai locals for fixing the damages of the levees.	1/ 09
The usage of freshwater to expel the saltwater	- In the case that saltwater invades into the freshwater canal, the locals will use the feed pump to expel the saltwater out of the canal. Then the chair of the group will submit a request to the Water Distribution Department, the Royal Irrigation Department to diversion more freshwater from the irrigation canal into the local freshwater canal.	1/ 09
The saltwater barrier gate	- The saltwater barrier gate can protect both floods and saltwater invasion. But the gate was not built properly, rusty, and got some damages. Also, there was something clogged at the channel of the gate.	1/ 06

**Table 4.9** Current operating projects to handle a sea level rise situation in Bang Khun Sai sub-district (cont.)

<b>Current operating projects</b>	<b>Details</b>	<b>Interviewees (persons)/ Code</b>
Improvement of the drainage system	- There is an improvement of the drainage system including dredging the canal annually to prevent floods. This project receives the budget from the local authorities and other organizations.	2/ 06, 09
The mangrove forest conservation	<p>- Protection of trespassing the mangrove forest by always patrolling, monitoring the status of the forest, enforcing the punishment to the trespasser.</p> <p>- Volunteering afforestation for the mangrove forest by providing the seedlings to the volunteers. Also, giving suggestion to the volunteers to plant the seedlings in the inner area of the forest due to the seedlings cannot resist the winds and waves well.</p> <p>- Making awareness of the mangrove forest conservation to the young generation and the locals by holding seminars, public stages, and other activities to disseminate this knowledge to the students and the locals.</p> <p>- Creating the conservation networks as in a type of volunteers such as the Bang Khun Sai Subdistrict Marine Resource Conservation Group. This way the locals can help monitoring and maintaining the mangrove forest, as well as protecting any trespass to the forest. However,</p>	6/ 02, 03, 06, 07, 08, 09

**Table 4.9** Current operating projects to handle a sea level rise situation in Bang Khun Sai sub-district (cont.)

<b>Current operating projects</b>	<b>Details</b>	<b>Interviewees (persons)/ Code</b>
The zoning of land use	<p>there is no collaboration in planning any guideline yet. In the past, there was fundraising from the locals to support the operating group. Currently there are some budget supported by the local authorities and the private sector.</p> <p>- The zoning of land use was used to divide the area to be used in saline aquaculture, salt farming, and agriculture. However, it was not practical due to the conflicts from some group of people who lose their benefit.</p>	3/ 01, 06, 09

Note: The in-depth interviewee code 01, 02 and 03 are the official authorities for natural resources and environmental management, the in-depth interviewee code 04 and 05 are the official authorities for monitoring and planning the vocational plan, the in-depth interviewee code 06 is the local authority who directly oversee the areas, and the in-depth interviewee code 07, 08 and 09 are the local experts.

For the future guidelines for dealing with a sea level rise in the Bang Khun Sai areas, there is some information gathered from sample groups. After that, the information is classified based on the guidelines for managing with the impacts of a sea level rise from the IPCC (1990) consisting of 3 guideline methods i.e., the retreat methods, the accommodation methods, and the protection methods that were used as the themes. In addition, the other methods theme, which could not be classified by using IPCC guideline, was also added to the research.

It was discovered that the future guidelines that the in-depth interviewees mentioned are as follows: 1) the retreat methods such as migrating to the upland or the

onshore area, 2) the accommodation methods for example elevating the building or the construction permanently, elevating objects temporarily during the maximum sea level rise, land filling, adjusting the career, and fundraising to support the prevention of the impacts of sea level rise, 3) the protection methods such as constructing, reinforcing or improving the saltwater barrier road, the saltwater levee, the saltwater barrier gate, the drainage system, boosting the sandbags, dredging the canals around the area, managing water resources as well as protecting and maintaining the mangrove forest, and 4) the other methods for example such as conducting a research and collecting the information involved with a model construction and risk areas simulations as well as creating networks for collaboration and data dissemination.

The most repetitive methods answered by 6 interviewees was the protection methods as follows: reinforcing/elevating the saltwater levees which is altered by the condition of each area including the sea level rise, as well as protecting and sustaining the natural mangrove forest to preserve the benefits from the ecological service of ecosystem. Subsequently, the second most repetitive methods answered by 4 interviewees was the accommodation method for example adapting the current dwelling area by land filling to elevate the land height which is varied by a sea level rise, improving the saltwater barrier gate so it can be used efficiently, studying and collecting data about a sea level rise, generating collaboration networks among the government sector, the private sector and the local sector, as well as information dissemination and data updates about the impacts that perhaps occur in the future so that people can handle them correctly. The details about the guidelines were displayed in Table 4.10.

It can be seen that both the accommodation and the protection methods should be carried out simultaneously i.e., the utilization of hard structure protection and soft structure protection along with conducting additional research and disseminating information to public as well as creating collaboration network for producing the best result in management of a sea level rise impacts. The in-depth interviewee code 05 suggested that *“There should be proactive operation by means of the precautionary principle of which the budget for the operating prevention is much less than that of the correction or damage restoration that may occur in the future.”*

The least practical methods for the future guideline that most respondents thought they were quite impossible in practice were as follows: the zoning of land use and the relocation of permanent construction to increase the retraction distance of the mangrove forest and the mudflat areas. Although, there was only 1 in-depth interviewee proposed the method to migrate people to the higher/upper areas or to the areas that are not affected by a sea level rise, but he also suggested that *“Migrating people should be the last method to do in case that no other options are available.”* (the in-depth interviewee code 04). Nevertheless, other interviewees thought that it was hardly possible to migrate people due to the cost of the land is quite expensive at present.

**Table 4.10** The future guidelines to handle a sea level rise situation for Bang Khun Sai sub-district

<b>Future Guidelines</b>	<b>Details</b>	<b>Interviewees (person)/ Code</b>
<b>1. Retreat methods</b>		
1.1 Migration to the higher/upper areas or the onshore areas	- Migrating people to the higher areas or the areas that are not affected by the impacts of a sea level rise. However, this method should be the last option to do. At first, people should use accommodation method to be able to live in the current area.	1/ 04
<b>2. Accommodation methods</b>		
2.1 Elevating the building or the construction permanently	- Elevating the house according to the old structure of the house and that budget. - If there is any construction near the coast, there should be a plan to manage or prevent any risk of a sea level rise.	1/ 08

**Table 4.10** The future guidelines to handle a sea level rise situation for Bang Khun Sai sub-district (cont.)

<b>Future Guidelines</b>	<b>Details</b>	<b>Interviewees (person)/ Code</b>
2.2 Elevating some objects temporarily during the maximum sea level rise period	- For the dwelling area where it is not permanently a floodplain but still affected by the sea level rise occasionally, it is recommended for the people to hoist some appliances and objects to the higher location.	1/ 09
2.3 Land filling	- People should fill their own land so it is elevated and varied by a sea level rise.	4/ 03, 05, 07, 08
2.4 Adapting the occupation	- Adapting the occupation that is suitable to the altered area such as changing from rice farming to salt farming, saline aquaculture or coastal fishery. By the related authorities should provide some suggestion for people for changing their jobs.	2/ 04, 06
2.5 Fundraising	- Fundraising to support the public prevention of floods.	1/ 09
<b>3. Protection methods</b>		
3.1 The saltwater barrier road	- The strength reinforcement and elevation of existing saltwater barrier road No. 1.	2/ 05, 07
3.2 The saltwater levee	- Elevating the height of saltwater levee as it should be varied by a sea level rise and the condition of the areas by choosing proper materials.	6/ 01, 03, 05, 07, 08, 09

**Table 4.10** The future guidelines to handle a sea level rise situation for Bang Khun Sai sub-district (cont.)

Future Guidelines	Details	Interviewees (person)/ Code
3.3 The saltwater barrier gate	<ul style="list-style-type: none"> <li>- People should protect themselves by building the water levee for their dwelling areas.</li> <li>- For the salt farmer or aquaculture farmer, the levees should be built along the farming area with proper height.</li> <li>- Improving the saltwater barrier by choosing the anti-rust material. There should be some routine maintenance regularly and remove all objects that clog the gate.</li> <li>- The arc shape gate is recommended due to it can be open-closed easily.</li> <li>- People should close the gate near their vegetable patch during the maximum sea level rise.</li> </ul>	4/ 01, 05, 06, 09
3.4 Improvement of the drainage system	<ul style="list-style-type: none"> <li>- Installing the water inlet-outlet system efficiently.</li> <li>- People should take care and manage the drainage system in their own area.</li> </ul>	2/ 03, 06
3.5 Boosting the sandbags	<ul style="list-style-type: none"> <li>- Placing the sandbags at the saltwater barrier gate to enhance the efficiency in preventing the saltwater infiltrating into the inland area.</li> <li>- For the protection of the household level, the sandbags should be places and then pump the infiltrated saltwater out.</li> </ul>	2/ 05, 06

**Table 4.10** The future guidelines to handle a sea level rise situation for Bang Khun Sai sub-district (cont.)

Future Guidelines	Details	Interviewees (person)/ Code
3.6 Dredging the canals around the area.	- Dredging the canals around the area to prevent the saltwater infiltration. Also, there should be a water pump system.	1/ 01
3.7 Water resources management	- Campaigning about maintaining the freshwater resources so they will not become the shoal water resources and the reserved water will be used in the ecosystem protection, i.e., using freshwater to expel the saltwater, preventing saline soil problem.	1/ 05
3.8 Protection of the mangrove forest	- Increasing the area of the mangrove forest so it becomes a whole forest, not being dispersed. The width of the mangrove forest line should be at least 300 m so it can prevent the impacts of a sea level rise. The guidelines for increasing the mangrove forest area are the prevention of trespassing, the afforestation in the existing forest line and in the drought season without winds and waves so the seedlings can survive , and the usage of the trawl to debar the mangrove seeds swept out into the sea but rather have them root into the clay.  - Creating public awareness about the mangrove forest conservation to urge people in protecting and maintaining the mangrove forest.	6/ 02, 03, 04, 07, 08, 09

**Table 4.10** The future guidelines to handle a sea level rise situation for Bang Khun Sai sub-district (cont.)

<b>Future Guidelines</b>	<b>Details</b>	<b>Interviewees (person)/ Code</b>
<b>4. Other methods</b>		
4.1 Research and data collection	<ul style="list-style-type: none"> <li>- Engaging in research about the sea level rise and the guidelines for solving the problem systemically.</li> <li>- Studying the suitability of the guidelines such as feasibility study of the embankment.</li> <li>- Conducting research about the proactive action and precautionary principle.</li> </ul>	4/ 01, 02, 04, 05
4.2 Construction a model and a risk map	<ul style="list-style-type: none"> <li>- Constructing the data base about the risk area from a sea level rise such as inundation area. So there will be a plan for coping with the impacts efficiently.</li> </ul>	2/ 01, 04
4.3 Creating collaboration networks	<ul style="list-style-type: none"> <li>- Planning a policy to handle the impacts explicitly and use it as a master plan.</li> <li>- Collaboration from many sectors i.e., the government sector, the private sector, and the local sector.</li> <li>- There should be an advisory organization that can provide both academic and technical advice for the local authorities.</li> </ul>	4/ 01, 02, 04, 05
4.4 Information dissemination	<ul style="list-style-type: none"> <li>- There should be some public relations to disseminate the information regarding sea level rise to the related organizations, the local authorities and the locals.</li> </ul>	4/ 01, 02, 04, 05

**Table 4.10** The future guidelines to handle a sea level rise situation for Bang Khun Sai sub-district (cont.)

Future Guidelines	Details	Interviewees (person)/ Code
	- Supporting or giving advice to the public so people can accommodate themselves to handle the impacts of a sea level rise.	

Note: The in-depth interviewee code 01, 02 and 03 are the official authorities for natural resources and environmental management, the in-depth interviewee code 04 and 05 are the official authorities for monitoring and planning the vocational plan, the in-depth interviewee code 06 is the local authority who directly oversee the areas, and the in-depth interviewee code 07, 08 and 09 are the local experts.