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Assessing the Preference of the Public for Environmental Quality Improvement Schemes Using Conjoint Analysis Method: the Case of the Ping River, Thailand

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Abstract

A socially acceptable environmental policy requires that rational policy decisions regarding resource allocation be based on an informed assessment of the preference of the public for different environmental quality improvement schemes. Conjoint analysis method was employed to assess the preference of the residents of Chiang Mai District in Northern Thailand for the five plausible alternatives for the Ping River quality improvement. The five schemes or alternatives were identified following focus group discussions with selected residents. The alternatives suggested by the residents are restoring reclaimed river bank, halting direct domestic and industrial waste disposal to the river, controlling gravel mining, controlling the use of chemical fertilizers, and promoting afforestation programs in upland areas. In this paper, the most preferred and the least preferred alternatives are presented. In addition, how preference for each alternative is affected by personal characteristics of the respondents and different attributes of the alternatives are explained.

1. Introduction

Traditionally, choice of instruments for environmental quality improvement has been guided by cost-benefit analysis (CBA). However, often, CBA analyses fail to take into account the preferences of the public. This would in turn reduce the efficiency of the intervention. Efficient and socially acceptable environmental policy both from economic and political perspectives therefore requires that rational policy decisions regarding resource allocation be based on an informed assessment of the preference for environmental quality improvement schemes (Geiorgio *et al.* 2000) using participatory approach.

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This would contribute to the promotion of development projects that meet the interests and needs of the public (Avritzer, 2003) including many of the less favored groups of the society. Johnston *et al.* (2001) highlighted that many watershed development projects around the world have performed poorly because they failed to take into account the needs, constraints and practices of local people. They further argue that participatory watershed management — in which users help to define problems, set priorities, select technologies and policies, and monitor and evaluate impacts — is expected to improve performance.

Policy makers are often faced with challenges to make decisions that involve tradeoffs between different environmental quality improvement schemes mainly due to resource constraints. The decisions that they make need to be well informed so that the welfare of the public is maximized. One of the techniques used in dealing with such situations is the conjoint analysis method. The method combines economic theory of the utility individuals gain from goods and/or services with economic theory of the value derived from goods and services as characterized by their specific attributes (Houston *et al.* 2002). Conjoint analysis method is increasingly being used to assess the preferences of the public for different environmental quality improvement alternatives (e.g. Farber and Griner, 2000; Turpie and Joubert, 2001).

Conjoint analysis can be used to assess the preference of citizens for "predetermined" choice sets or to determine "optimal" configuration of a product or service (Adler *et al.*. 2010) which involves different permutations of attribute levels. In this study, the method is used to assess the preference of the residents of Chiang Mai District for a set of predetermined alternatives for river water quality improvement. The alternatives and their attribute levels were designed through active participation of key stakeholders using focus groups discussions (see *survey design* section).

The central objective of this paper is to assess and elicit more information about the citizens' preference for the Ping River quality improvement schemes and to examine how respondent characteristics, and attribute levels of the given alternatives affect the likelihood of an alternative being ranked as most-preferred alternative. This study also intends to answer key decision making process question; i.e. who prefers which alternative and why? This is expected to help policy makers to tailor a well-informed, socially accepted, and efficient policy for the conservation of the Ping River, which ultimately could enhance the welfare of citizens.

2. The Ping River

Water, rather than land, is the defining element of Southeast Asia, where human relationship to water has long formed the basis of existence (Rigg, 1992). Its deltas and main valleys, in particular, were aquatic environments which have been transformed into the rice bowl of the region (Francois, 2001). The Kingdom of Thailand covers a land area of 513, 115 square kilometers. The country extends 1,500 kilometers from north to south, and 800 kilometers from east to west. The North is mainly mountainous and is the source of four major rivers, namely: Ping, Wang, Yom, and Nan, which converge to become the Chao Phraya River (Water Environment Partnership Asia [WEPA], 2008). The major and biggest tributary to the Chao Phraya River is the Ping River. The Ping River, which is known by the locals as 'the lifeline of Chiang Mai', is 560 km long and has its sources in the mountains near Chiang Dao, in the northernmost part of Chiang Mai Province.

According to reports from the National Statistics Office of the Kingdom of Thailand on the number of villages and households which declared that they utilized river water resources for agricultural use during the fiscal year 2004, the Northern region ranked top compared to the other parts of the country (Central, Northeast, and South) at 8,188 villages and 564,169 households respectively (National Statistical Office, 2008). In addition, the same report asserts that among the major rivers in the North, the use of water resources from the Ping River ranked top at 66.8 and 34.9 million cubic meters for household and industrial use respectively. This implies the significance of rivers, most importantly the Ping River, in the daily life of the people and economic engine of the North.

Even though there is no recorded water quality parameters which show the change of the river quality over time, documented pictures from the mid 20th century show that the river was swimmable, navigable, clear and wide with gentle water velocity. The present image is different. The river is unswimmable, turbid, narrow, significantly depleted fisheries resource, and very high average water velocity. Residents claim that flooding which was once infrequent has become an annual event.

Volker (1983) states that because of the growing population and the attempt to improve the nourishment of people, the need for more agricultural production and crop diversification came to the fore. The introduction of high-yielding varieties of rice and the expansion of horticulture are only possible if the surface and groundwater levels can be controlled, which leads to hard structure embanking, artificial drainage system, which significantly alter the hydrological system of the river. Rapid economic growth and unsustainable use of river resources are also to blame.

3. Conjoint Analysis

3.1. The Method

The main theoretical foundations of conjoint analysis are in consumer theory and its main applications have been in marketing (Arifin *et al.* 2005). It has been used extensively in environmental economics since the beginning of the last decade (e.g. Farber and Griner, 2000; Turpie and Joubert, 2001). As is mentioned by Georgio *et al.* (2000), economic theory posits that the objective of society is to maximize human welfare. Since welfare to the economist is a state of human perception, great emphasis is placed on how individuals perceive their welfare and hence on the concept of preference. Economic theory asserts that there exists a utility function that represents preferences. The aim of the individual is thus to attain the highest level of utility. This is the axiom of utility maximization. Looking at pollution control or acceptable environmental policy from an economic perspective therefore requires that rational policy decisions regarding resource allocation be based on an informed assessment of the utility (or benefits) of environmental improvement (Turner *et al.* 2004: 578). One of the methods to assess the preferences of the public is the conjoint analysis method.

Conjoint analysis is a survey based technique designed to isolate the value of individual product characteristics (attributes) which are typically supplied in combination to one another. In conjoint analysis surveys, respondents are asked to rank (contingent ranking), rate (contingent rating) or chose their most preferred alternative (choice experiment). The technique was introduced by Beggs *et al.* (1981) and Chapman and Staelin (1982) for automobile and college choices respectively, and was first applied in environmental economics by Rae (1982, 1983).

3.2. Model Specification

The concept of conjoint analysis in random utility model is extracted from Georgio *et al.* (2000) and Bateman *et al.* (2001). A random utility model (RUM), a widely applied model of consumer behavior that involves discrete choices, is used to model the observed rankings. In RUM, the individual is assumed to select alternatives that provide the highest utility level. Each response is differentiated by the rank of a given alternative and by the levels of the attributes of that alternative (Georgio *et al.* 2000). The response is not a set of 1s and 0s but a set of integers from 1 to k giving each scheme's rank (Bateman *et al.* 2001). Information on the choice ranked 1^{st} by the respondent indicates that his/her utility for that choice is greater than the utility for alternative choice they have.

Individual i's probability of selecting alternative k, given Q_k — a vector of levels making up the attributes of the environmental quality improvement alternative, and Z_i — a vector of characteristics of the i^{th} respondent, is defined by the probability that i's utility of k will exceed the utility of all other alternatives:

$$\Pr\,[U_{i1} \geq U_{i2} \geq \cdots \geq U_{ik}] \cdots\cdots\cdots\cdots \text{[1]}$$

Suppose the utility functions have an additively random structure;

$$U_{ik} = V_{ik}(Q_k, Z_i) + \varepsilon_{ik} \cdots\cdots\cdots\cdots \text{[2]}$$

Where V_{ik} is the indirect utility function and ε_{ik} is a random unobservable component that is unique to each respondent. Therefore,

Pr {alternative 1 ranked 1^{st} $\geq$ alternative 2 ranked 2^{nd} $\geq$ . . . $\geq$ alternative k ranked last} =

$$\Pr\{V_1(Q_1, Z_i, \varepsilon_1) \geq V_2(Q_2, Z_i, \varepsilon_2) \geq \cdots \geq V_k(Q_k, Z_i, \varepsilon_k)\} \cdots\cdots\cdots \text{[3]}$$

Using probit specification Beggs *et al*. (1981) express the probability that alternative j is ranked higher than alternative *k* as:

$$\Pr(U_j > U_k, j \neq k) = \frac{e^{v_j}}{e^{v_j} + e^{v_k}} \quad [4]$$

Unlike most other works done (Ben-Akiva *et al.* 1992; and Bradlow and Fader, 2001) which used a rank-ordered logit model, Schechter (2009) uses rank-ordered probit model to analyze ranked data. The main reason for this is that rank-ordered logit model assumes that the ratio of the probabilities of any two alternatives is constant, no matter what other alternatives are presented to the individual (Schechter, 2009). Schechter further explains quite convincingly that the rank-ordered probit model allows each alternative to have a random component with a complete variance-covariance structure. Under such assumption, rankings from best to worst are not compatible with rankings from worst to best. According to Schechter (2009) rank-ordered probit does not suffer from such incompatibility. Thus if one believes that respondents may not necessarily think through their decisions from best to worst, then the rank-ordered probit specification is preferable to that of rank-ordered logit. In this study (see next section) some respondents found it easy to rank from the least to the most preferred alternative or even irregularly; for example, ranking the second most preferred alternative first, then the third, and then the first and so on. Therefore, convinced by Schechter's argument rank-ordered probit model was used to analyze the ranked data.

4. Survey Design

In order to develop well informed and consented river quality improvement schemes it is very crucial to hold consultations with local communities who are directly affected by the environmental quality in question and policy makers. Focus group discussions with 36 respondents evenly divided into three groups were conducted to determine the use value of the river, main problems the river is facing and possible solutions. The use values of the river were identified as: (1) a source of water (including for household use, irrigation, groundwater recharge, and municipal use such as firefighting and cleaning); (2) tourist attraction; (3) cultural importance; (4) fishing; and (5) as a symbol of Chiang Mai. The participants of focus group discussions also identified key problems which can be categorized as upstream and downstream borne problems. Upstream problems include deforestation and the use of chemical fertilizers and pesticides. According to participants, deforestation increased siltation and intensified river velocity. Deforestation in upstream areas has significantly deteriorated water quality of the river (Wasan Jombakdee, *pers. comm.* March 12th, 2009). The use of chemicals in upstream farms degraded the river water quality and consequently depleted fish stock. Downstream problems mentioned by the respondents were mainly direct domestic and industrial waste disposal, river bank encroachment and unsustainable gravel mining for construction purposes.

In the focus group discussion participants identified five possible key solutions which are stated as 'alternative choices' in Table 1. The participants were further asked to indicate how they would expect the stated solutions or alternatives to change the quality of the river quality given the five attributes namely: clean source of water, groundwater recharge, fishery, flood control, and tourist attraction. The levels of improvement were indicated in four subjective levels as: no improvement (*mai chuai pattan loei*), small improvement (*chuai pattan lek noi*), medium improvement (*chuai nai radap pan klang*), and large improvement (*chuai pattan mak*) relative to the current level. The levels of improvement were taken from everyday language of the local Thais. This was used to describe levels of improvement in an easily understandable way from the local people's perspective. Initially, attribute levels were defined through consultation with environmental engineers and hydrologists from the Municipality of Chiang Mai, academics and geophysicists from University of Chiang Mai. However, since the figures indicating different attribute levels were not easily comprehensible by the local people, it was decided that subjective improvement levels are used instead.

Subjective attribute levels were used for two main reasons. Firstly it is important that respondents clearly understand the changes in attribute levels. The local residents tend to consistently rate improvement levels in four stages; i.e. no improvement, small improvement, medium and large improvement. This was much more comprehensible than the use of biophysical information (e.g. concentration of particulate matter) which is used by some studies. Secondly, even though there was a commonly agreed status-quo scenario, there is no existing biophysical data which shows the historical changes in river quality. This problem is common in many low income countries. Therefore, pictures taken in the 1960s were used to explain the levels of change since then. Large improvement for example would mean to get back to the 1960s scenario.

A small survey to pre-test whether the list of attributes and their levels are commonly agreed was conducted. The attributes and their levels were further discussed with foresters, environmental engineers, academics from Chiang Mai University, and municipality officers from within Chiang Mai city. The finalized format of the conjoint choice analysis question was presented as is seen in Table 1. Each alternative was presented in one card. A set of five alternatives with their respective attribute levels were presented to respondents and they were asked to express their preference from their most preferred to the least preferred alternative. It must be noted that respondents were given the freedom to rank the alternatives in any order that pleased them.

Respondents were presented with ranking question following the section which asked attitudinal and behavioral questions, followed by socio-economic section. The sequence of the questions was decided after conducting pre-test with different sequences of the sections of the questionnaire. When the ranking question was presented after the socioeconomic section which is the final part of the questionnaire, the respondents seemed to have felt the burden of extra exercise and were reluctant to extend their cooperation and answer the ranking question. In the contrary, presenting the ranking section prior to the socioeconomic question enabled the respondents to feel more relaxed as they

Table 1 The Contingent Ranking Question Format

Attributes	*Alternative Choices*				
	Restoring reclaimed river bank (Restore)	Halting domestic and industrial waste disposal (WasCon)	Controlling gravel mining (SanCon)	Promoting afforestation upstream (Afforest)	Control the use of chemicals in upstream farms (ChemCon)
Clean source of water	Small improvement	Large improvement	Medium improvement	Large improvement	Large improvement
Ground water recharge	Medium improvement	No improvement	Large improvement	Large improvement	No improvement
Fishing	Large improvement	Large improvement	Large improvement	Large improvement	Large improvement
Flood control	Large improvement	No improvement	Medium improvement	Large improvement	No improvement
Tourist attraction	Small improvement	Large improvement	Large improvement	Medium improvement	Small improvement
Ranking (rank 1–5)	[ ]	[ ]	[ ]	[ ]	[ ]

noticed they were coming towards the end of the interview with much simpler questions that relatively do not require much thinking. Indistinguishable from the statement made by Bateman *et al.* (2006) it is not claimed that the derived results would be invariant to changes in this order, however such concerns were not central to the objectives of this survey.

The survey was conducted in Chiang Mai district. Stratified random sampling was used. The district is divided into 16 administrative sub-districts. On average 22 households were interviewed from each sub-district. The households from each sub-district were selected randomly by skipping equal number of building blocks depending on size of the sub-district. Sub-districts were used to stratify the target population because each sub-district was socioeconomically distinct e.g. ethnicity, income group, main income generating activity and so on. A total of 349 in-person interviews were conducted in Thai language by local enumerators who are fluent in northern Thai dialect; *Pasa Chiang Mai*.

While 347 interviewees answered all attitudinal, behavioral and socioeconomic sections of the questionnaire, only 307 subjects fully completed the ranking question. This further backs the argument made by Foster and Mourato (2002) that the process of ranking imposes a significant cognitive burden upon respondents that is positively related to the number of attributes included and the number of alternatives presented. There is no literature that tells how many alternatives and attributes must be presented. Caplan *et al.* (2002) state that if a respondent faces only three options, it is a relatively easy task for the individual to determine the least and most preferred choices; by default, the remaining choice is the second most preferred. Nonetheless, as argued by Schechter (2009), a choice between five alternatives is not excessive compared to other experiments using ranked data. Each of the 307 respondents ranked the five alternatives from their most preferred to the least preferred providing (307×5) 1535 observations.

5. Empirical Findings

5.1. Descriptive Statistics

A total of 307 subjects provided reliable ranking data. 12 per cent of the respondents were affiliated to an NGO or group working on environmental conservation of any sort and 87 per cent of the respondents believe that the river is facing a serious problem. The average distance of the respondents' house was 5.15 km from the river. The number of male (42 per cent) and female (58 per cent) respondents was almost equally proportional. The demographic characteristics of the respondents are summarized in Table 2.

As can be seen from Figure 1, the second alternative (controlling direct industrial and domestic waste disposal) was the most preferred alternative by 36 per cent, followed by the fourth alternative (afforestation in upstream lands) by 32 per cent. The third most preferred alternative was 'restoring reclaimed river bank' by 16 per cent, followed by 'controlling gravel/sand mining at its sustainable level' and 'controlling chemical use in upstream farms' by 9 per cent and 7 per cent respectively. On the other hand, as is shown in Figure 2, 37 per cent of the subjects ranked alternative 1 (restoring reclaimed section of the river bank) as their least preferred alternative, followed by controlling chemical use in the upstream farms as second least preferred alternative by 22 per cent. As stated above, in the model specification section, the choice of a given product or alternative depends on the characteristics of the person making a choice and the characteristics of the product by itself. Therefore, in the following sub-sections how individual characteristics and attributes of each alternative affect ranking will be discussed.

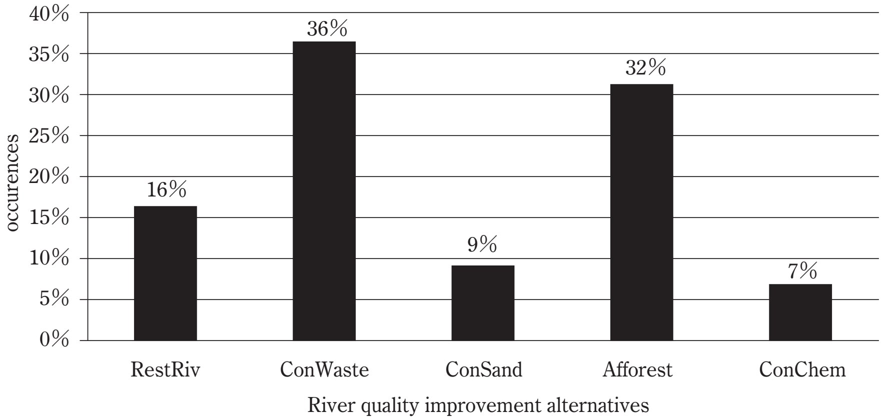
5.2. Preferences and Respondents' Characteristics

The choice of a given product or alternative depends on individual characteristics. Using *alternative specific rank ordered probit model* ranking results were regressed against respondents' characteristics which include: affiliation of the subject to non-governmental organizations (NGOs) or non-profit organizations (NPOs), whether the subject thinks the Ping River is facing serious problem, distance between the river and the subject's residence, willingness to pay for the conservation of the Ping River which was elicited using the payment card approach (*see* Mohammed, 2009), and educational attainment expressed in years of schooling. Affiliation of the subject to organizations or other groups directly working for the conservation of the Ping River was taken as a proxy for the person's behavior. In addition, asking subjects whether they think the river is facing a serious problem was taken to see

Table 2 Statistical Summary

Variable	Definition	Mean (Std.dev.)
Affl	1=if the respondent is member of anygroup (NPO, NGO, etc) closely working for the conservation of MaePing 0=otherwise	0.12 (032)
SerProb	1=if the respondent thinks the Ping River is facing serious problems 0=otherwise	0.87 (0.34)
Distance	Distance of the respondent's residence from the Ping River in Km	5.16 (7.99)
Gender	1=ifmale 0=otherwise	0.42 (0.49)
Age	Age of respondent in years 40.91	(13.78)
Employed	1=if form all yemployed 0=otherwise	0.41 (0.49)
SelfEmpl	1=if self-employed 0=otherwise	0.45 (0.49)
HHmem	Number of household members	4.02 (1.91)
Educ	Year of schooling	12.92 (4.72)
Income	Total household monthly in come in Thai Baht	13034.58 (8554.92)
N	Number of observations	307

Figure 1 Histogram of the Most Preferred Alternatives



if their attitude towards the environment in general and the river in particular affects the subject's preference for a given alternative.

As is shown in Table 3, by default, afforestation in upstream areas (*Afforest*) is taken as a base alternative, and controlling chemical use (*ChemCon*) as an alternative normalizing scale. Therefore, the case specific rank ordered probit model result presents the interaction between subjects'

Figure 2 Histogram of the Least Preferred Alternatives

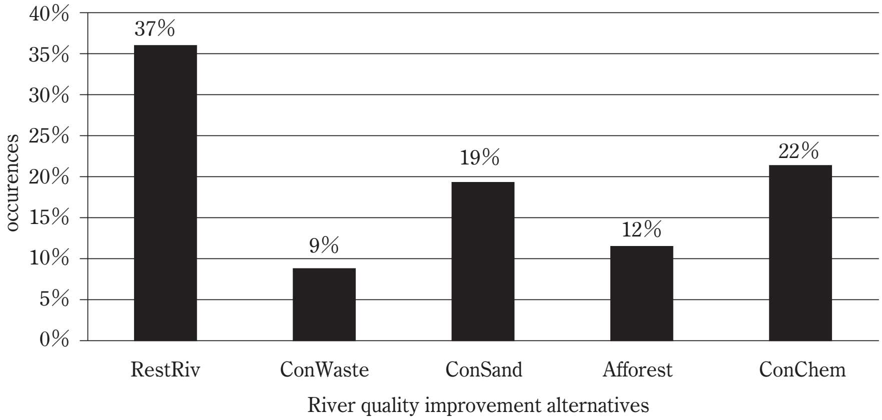


Table 3 Case Specific Rank-Ordered Probit Model. N=307

Casespecific var.	Alternatives			
	ChemCon	Restore	SanCon	WasCon
affl	−0.05 (0.30)[a]	0.44 (0.36)	0.49* (0.27)	0.04 (0.34)
serprob	−0.58** (0.27)	−0.59* (0.32)	−0.30 (0.25)	−0.59** (0.31)
distance	0.025* (0.01)	0.02 (0.02)	0.007 (0.01)	0.03** (0.02)
lnwtp	0.13* (0.07)	−0.02 (0.09)	−0.01 (0.07)	0.04 (0.08)
educ	−0.03 (0.02)	−0.07*** (0.02)	−0.004 (0.02)	−0.03 (0.02)
cons	−0.16 (0.39)	0.54 (0.47)	−0.29 (0.36)	0.73 (0.44)

Prob>chi^2=0.03
Afforestation=base alternative
ChemCon=alternative normalizing scale
[a]Standard error in parentheses
Single, double, and tripleasterisks (*) indicate levels of significance at 10percent, 5percent, and 1percent respectively.

characteristics and four alternatives namely: controling chemical use in upstream farms (*ChemCon*), restoring reclaimed river bank (*Retore*), controling sand and gravel mining (*SanCon*), and controling direct waste disposal to the river (*WasCon*). The interpretation of the coefficients is different from a simple OLS regression result. Since the alternatives were ranked from 1 to 5, 1 being most preferred and 5 being least preferred, a negative sign indicates that, for any given alternative, a respondent with the given characteristic is more likely to rank the alternative as most preferred relative to those who do not share the characteristics. In the contrary, a positive sign indicates that, for a given alternative, a respondent with the given characteristic is less likely to rank the alternative as most preferred relative to a respondent not sharing the characteristic. Moreover, since afforestation is taken as base alternative therefore, the comparisons in the likelihood of being ranked higher or lower are interpreted relative to afforestation.

The coefficients of individual characteristics affecting the likelihood of ranking *ChemCon* relative to *Afforest* are presented in Table 3. The coefficient for *serprob* is negative and statistically significant at 5 per cent level of significance. This indicates that respondents who believe that the river is facing serious problem are more likely to rank *ChemCon* as the most-preferred alternative relative to *Afforest*; while the coefficients for distance and *lnwtp* (natural logarithm of willingness to pay) are positive and statistically significant at 10 per cent level of significance indicating that the further the subject is from the river the likelihood of the person ranking *ChemCon* as most-preferred is low relative to *Afforest*. Even though the coefficients of *affl* and *educ* are not statistically significant, they both have negative signs indicating that those who are affiliated to a group working on environmental conservation and/or with higher educational attainment are more likely to rank *ChemCon* as most-preferred alternative.
Table 3 shows how individual characteristics affect the probability of ranking *Restore* as most-preferred alternative, the coefficients of individual characteristics. The coefficients of both *serprob* and *educ* are negative and statistically significant at 10 per cent and 1 per cent levels of significance respectively, indicating that if the subject thinks the river is facing serious problem and/or if the subject has higher educational attainment the probability that *Restore* will be most-preferred relative to *Afforest* will increase.

All coefficients but *affl* of the individual characteristics that affect the probability of ranking *SanCon* as most-preferred alternative are statistically insignificant. The coefficient of *affl* is positive and significant which indicates that the probability of *SanCon* being ranked as most-preferred alternative decreases if the person is affiliated to an NGO or NPO working for the conservation of the Ping River. This can also be interpreted as a respondent with an affiliation is more likely to rank *Afforest* as most-preferred alternative relative to *SanCon*.

The last section of Table 3 presents how individual characteristics affect the probability of ranking *WasCon* as most preferred alternative relative to *Afforest*. The coefficient for *serprob* is negative and statistically significant at 5 per cent level of confidence. This indicates that if a person thinks the river is facing serious problem then the probability of ranking *WasCon* as most-preferred alternative increases. In the contrary, the coefficient of distance is positive and statistically significant at 5per cent level which indicates that the further the person is from the river the probability of ranking *WasCon* as most-preferred alternative relative to *Afforest* decreases.

Table 4 Alternative Specific Rank-Ordered Probitmodel. N = 307

Case specific var.	Alternatives			
	ChemCon	Restore	SanCon	WasCon
Watqual	− 6.22 (39.90)	− 11.61 (60.17)	− 8.11 *** (.18)	− 6.44 *** (.25)
Grouwat	1.98 (199.47)	− 5.83 (60.16)	− 0.22 (.34)	− 6.14 *** (.78)
Floodcon	− 6.37 (279.25)	3.02 (60.16)	− 2.52 *** (.29)	1.92 *** (.49)
Tourism	− 4.19 (239.36)	− 0.12 (.21)	− 0.01 (.19)	− 4.15 *** (0.62)
cons	31.48 (598.37)	34.46 (180.47)	23.99 (132.82)	15.25 (207.52)

Prob > chi^2 = 0.000
Afforestation = base alternative
ChemCon = alternative normalizing scale
[a]Standard deviation in parentheses
Single, double, and tripleasterisks (*) indicatelevels of significance at 10percent, 5percent, and 1percent respectively.

5.3. Preferences and Alternative Characteristics

Based on the general notion employed in the model specification section, ranking of a given alternative is affected by the characteristics or attribute levels of that given alternative. Therefore, to see how the attribute levels affect the probability of ranking each alternative as most preferred alternative, the ranked data were regressed against the attribute levels. Each alternative had different combinations of subjective attribute levels which varied in the levels of improvement namely: no improvement, small improvement, medium improvement, and large improvement. These levels of improvement were given numeric codes which ranged from 0 (no improvement) to 3 (large improvement). *Alternative specific rank-ordered model* result is presented in Table 4 which presents the interaction between alternative specific attributes (*Watqual, Grouwat, Floodcon*, and *Tourism*, while *Fishery* was dropped because of collinearity) and four alternatives namely: *ChemCon, Retore, SanCon*, and *WasCon*.

As is portrayed in Table 4, statistically significant coefficients were found for *WasCon* and *SanCon* only. This raises a question on precision. Schechter (2009) has mentioned that some economists have pointed out that top ranked choices may be ranked with more precision than bottom ranked choices. Schechter explains that consumers are daily confronted with situations in which they choose their first choice, but are not often asked to rank the remaining alternatives, possibly resulting in decreasing precision of ranked choices. Furthermore, Carson *et al.* (1994) asserts fatigue effect as the main cause of decreasing precision of ranked choices. This seems to hold true in this study as well.

From Figure 1 above, it is clearly shown that *WasCon* is the most preferred alternative compared to other alternatives by 36 per cent. The coefficients of the attributes of these alternatives were found to be statistically significant (see table 4). On the other hand even though *Restore* appears to be more preferred than *SanCon* in figure 1; however, Figure 2 shows that *Restore* ranks top among the *least* preferred alternatives followed by *ChemCon* by 37per cent and 22per cent respectively. Therefore, this further backs the argument of decreasing precision of ranked alternatives.

As is shown in Table 4, the coefficients of the attributes that affect the probability of *WasCon* being ranked first are all statistically significant at 1 per cent level of significance. The coefficient of *Watqual* is negative indicating that a one unit increase in the level of improvement increases the probability of ranking *WasCon* as most-preferred alternative, again relative to *Afforest*. Similarly, a one unit increase in the level of improvement of *Grouwat* and *Tourism* increase the likelihood of ranking *WasCon* as most-preferred alternative relative to the base alternative, *Afforest*. In the contrary, an increase in the level of improvement in *Floodcon* decreases the probability of ranking *WasCon* as most-preferred alternative. This is mainly because the local people strongly believe that afforestation in upstream areas can significantly reduce the occurrence of flood. Even though there is no any site specific scientific proof showing any correlation between deforestation and flooding, it is natural that that people assume afforestation is more likely to minimize the occurrence of flood, compared to controlling domestic and industrial waste.

From the same alternative-specific rank-ordered probit model, one can also observe that an increase in the level of improvement of *Watqual*, which is negative and statistically significant at 1per cent level of significance, increases the probability of ranking of *SanCon* as most-preferred alternative as compared to *Afforest.* The same holds true for an increase in the level of improvement of *Floodcon*.

In general, a one unit increase in the level of improvement of *Watqual, Grouwat*, and *Tourism* increases the probability of ranking *WasCon* as most-preferred alternative relative to Afforest. On the other hand an increase in the level of improvement in *Floodcon* decreases the probability of ranking *WasCon* as the most-preferred alternative.

6. Discussion and Conclusions

The central objective of this paper is to assess and elicit more information about consumers' preference for the Ping River quality improvement schemes and to examine how individual characteristics of respondents and attribute levels of the given alternatives affect the probability of an alternative being ranked as most-preferred alternative or option.

A total of 307 subjects provided reliable ranking data. Controlling direct industrial and domestic waste disposal was the most preferred alternative by 36per cent, followed by promoting afforestation in upstream areas by 32per cent. The third most preferred alternative was 'restoring reclaimed river bank' by 16per cent, followed by controlling gravel and sand mining at its sustainable level and controlling chemical use in upstream farms by 9per cent and 7per cent respectively. On the other hand 37per cent of the subjects ranked the alternative aimed at restoring reclaimed section of the river bank as their least preferred alternative, followed by controlling chemical use in the upstream farms as second least preferred alternative by 22per cent . Nonetheless, the first initiative that is taken by the Municipality of Chiang Mai to improve the water quality of the river was restoring the reclaimed the riverbank. According to this study, this is counterproductive for at least two reasons; firstly the people who were evacuated and lost their property under the pretext of 'restoring the reclaimed riverbank' were the voiceless poor which characterizes the intervention as unfair. Secondly if schemes that are less popular are implemented, which according to Beder (2000) the initiative could potentially lose legitimacy and consequently lose cooperation by the people which can ultimately threaten the success of the intervention. Therefore, we recommend that the municipality of Chiang Mai tailors its intervention to fit with the preference of the residents. The municipality authorities should introduce interventions that control direct waste disposal to the river and promoting afforestation in upstream lands which are the residents' most preferred alternatives.

Controlling direct industrial and domestic waste disposal to the river can be done either through the introduction of economic instruments or construction of waste treatment plant. Existing environmental Acts and policies explicitly address responsibilities of stakeholders and financing mechanism for the installation of waste treatment plants. Section 70 of the Enhancement and Conservation of National Environmental Quality Act, 1992 states that "the owner or processor of the point source of pollution ...has the duty to construct, install or bring into operation an on-site facility for wastewater treatment or waste disposal as determined by the pollution control official." Furthermore, Section 72 of the Act underlines that "in any pollution control area or locality where the central wastewater treatment plant or central waste disposal facility has been brought into operation by the administration concerned, the owner or processor of any point source of pollution is responsible to direct (solid or liquid) waste from the source of pollution to the central wastewater treatment plant." In addition Section 77 of the Act states that beneficiaries of the wastewater treatment plant shall pay for the service provided. The above policies and Acts are also backed by the Decentralization Act which was enacted in 1999. Section 17(5) of the Decentralization Act authorizes provincial administration offices to protect and maintain natural resources and the environment. In addition Sections 17(10) and 17(11) authorize concerned local government offices to construct and maintain wastewater treatment plants, and control waste disposal. Article 23 of the same Act gives the authority to Municipalities and Tambon (district) Administration Offices (TAOs) to generate revenue by imposing a levy for environmental protection services on (as stated in Article 28) utility bills.

Since the main objective of the study was to assess *who prefers what and why*, further analysis was done to explain how individual characteristics of subjects and attributes of each alternative affect preferences. Two rank-ordered probit models were presented one showing the interaction between individual characteristics and the hypothetical river quality improvement alternatives, and the second one depicting how changes in the levels of improvement of attribute of each alternative affected ranking. It was shown that those who believe the river is facing serious problem would favor direct actions such as controlling chemical (fertilizers and pesticides) use in upstream farms, restoring river banks, and controlling both domestic and industrial waste relative to afforestation program in the upstream area. This is mainly because they wanted to see immediate change on the improvement of the quality of the river, while afforestation would have a long term effect. In the contrary those who live far from the river tend to rank afforestation in upstream area as most-preferred alternative as compared to controlling chemical use in upstream farms (*ChemCon*) and controlling domestic and industrial waste (*WasCon*). This can be explained by the fact that those who live relatively far from the river are less affected by the direct physical, chemical and biological changes that lead to deterioration in scenic view and bad odor. In addition this was found to be commonsensical as afforestation programs would bring about wider benefit that can be enjoyed both by those who live adjacent to the river and relatively far.

Those respondents with higher educational attainment tend to favor restoring reclaimed riverbank over the other alternatives. In a follow up interview with some respondents, this is mainly because, even though most of the less educated respondents understood the importance of restoring the reclaimed river bank in improving the quality of the river, they always thought it is impossible to do so as those who have encroached upon the river bank are powerful businessmen with strong lobbying power. Furthermore, as stated earlier the measures that were taken by the municipal authority to restore reclaimed river bank left the poor displaced while hotels and big restaurants were spared.
Respondents who are affiliated to a groups working for the conservation of the Ping River are very likely to vote in favor of controlling sand and gravel mining relative to afforestation programs. In a follow up interviews with some members of NPOs and NGOs, it was identified that this is mainly because most environmental activists resent the uncontrolled gravel mining going on in the river and would want this to stop immediately.

An attempt was made to examine how changes in the attribute levels affect the likelihood of each alternative being ranked as most-preferred. A one unit increase in the level of improvement of *Watqual, Grouwat*, and *Tourism* increases the probability of ranking *WasCon* as most-preferred alternative relative to *Afforest*. On the other hand an increase in the level of improvement in *Floodcon* decreases the probability of ranking *WasCon* as the most-preferred alternative. In addition it was shown that an increase in the level of improvement of *Watqual*, which is negative and statistically significant at 1per cent level, increases the probability of ranking of *SanCon* as most-preferred alternative as compared to Afforest. The same holds true for an increase in the level of improvement of *Floodcon.* Therefore, if the desired outcome of the Ping River quality improvement project is to improve surface and ground water quality and quantity and promote tourism controlling domestic and industrial waste disposal should be given utmost priority. This can be done by establishing waste treatment plant. On the other hand if reducing the frequency and severity of flood is desired, afforestation programs in upstream areas should be promoted. However, even though there is a widespread belief that there exist link between forest and watershed services this should be scientifically proven as this may depend on forest, soil type, and the size of the river basin. There is no any scientific proof that shows the link between forest and watershed services in the Ping River basin to date. A comprehensive assessment on the preference of citizens should be considered in designing both socially acceptable and cost-effective policy for the improvement of the Ping River which in turn would maximize the welfare of citizens. Moreover, assessing public preference for environmental improvement schemes in a participatory or consultative approach can potentially generate relevant information for decision making and can be a means to design a strategy to communicate the plans to the people and achieve a public agreement.

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