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The influence of decision-making rules on individual preferences for ecological restoration: Evidence from an experimental survey

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Abstract

We conduct an experimental survey to analyze how rules for collective decision-making influence individual preferences regarding nature restoration plans. Our study compares two decision-making rules—a consensus rule and a majority rule—wherein participants decide on a plan regarding nature restoration in the Kushiro Wetland, Japan. Our main finding is that the difference between the individual preferences and collective decision-making is less significant under the consensus rule than the majority rule. Furthermore, there is a larger disparity with regard to the marginal willingness to pay between collective and individual decisions when participants are unsatisfied with the results of collective choice.

Keywords: Participatory approaches, Decision-making rules, Stated preference, Environmental valuation, Ecological restoration

1. Introduction

Along with the development and refinement of stated preference techniques, many studies have pointed out the tension between individual preference and social decision-making in the context of environmental management (Blamey, 1996; Sagoff, 1998; Russel et al., 2003; Vatn, 2004). For example, Blamey (1996) suggests that the respondents in a contingent valuation survey should not be treated as consumers of environmental goods, but rather as citizens who think of the welfare of the community when responding to environmental issues. Sagoff (1998) also suggests that consumer preferences reflect conceptions of the good life that individuals seek for themselves, while citizen preferences reflect conceptions of the good society offered to others for their consideration and acceptance.

Corresponding to these notions are several studies incorporating the participatory and deliberative approach within stated preference methodology (Davis and Whittington, 1998; Kenyon et al., 2001, 2003; MacMillan et al., 2002; Urama and Hodge, 2006). Examples of recent studies involve the stated preference survey in combination with the citizen's jury (Álvarez-Farizo and Hanley, 2006; Álvarez-Farizo et al., 2007) and theoretical analysis of the aggregation of values in a deliberative group decision (Howarth and Wilson,

2006). Although these studies suggest the significant role of the participatory approach, there have been no empirical and quantitative studies that systematically compare different decision-making rules employed in the participatory process with respect to their influence on individual preferences. A representative decision-making rule is a consensus rule according to which a proposal is discussed until there are no obvious objections. Although this may be useful in being able to convince the public who participate in the process, its relative performance with respect to other decision-making rules is indeterminable in the absence of a quantitative analysis. Since there are a variety of ways in which individuals reveal their collective views, a comparison would be useful in order to assess the validity of the participatory approach.

This study uses an experimental survey involving a stated choice (SC) questionnaire to investigate how decision-making rules applied in discussion-based meetings can have an impact on the result of collective choice and individual preferences. Our study aims to compare two decision-making rules—the consensus rule and the majority rule—in a situation wherein members of a group discussion decide on the preferable plan for nature restoration. In order to study the significance of decision-making processes, we form groups comprised of members of the general public and ask them to arrive

at a decision in the manner in which the actual committee members would determine a nature restoration plan.

2. Preferences and decision-making rules

The practical demand of an administrative agency for an operational decision-making tool has driven the institutionalization of cost-benefit analysis and stated preference techniques in project appraisal and regulatory impact assessment related to environmental and resource management (Morgenstern, 1997; U.S. EPA, 2000). As noted earlier, the practice has been challenged by the philosophical consideration of the tension between the individualistic and collective viewpoints. This line of argument often leads to the claim for participatory or deliberative approach (Sagoff, 1988, 1998; Brown et al., 1995; O'Hara, 1996; Spash, 2008).

A deliberative approach can be defined as a way to make recommendations on public policy through discussions by small groups of citizens. Authors such as Sagoff (1988), Vatn and Bromley (1994), and Norton (2005) support the procedural approaches to policy analysis that are grounded in democratic principles. In contrast to the perspective that the governance of society is necessary for maximizing social welfare, discussion-based consensus is rooted

in democracy in terms of governance through consent of the governed (Rawls, 1971; Buchanan, 1977; Binmore, 1998).

Sagoff (1998) stresses that individuals may participate in an interactive process in which they construct collective judgments as citizens on the value of an environmental good, rather than serving merely as channels indicating consumer preferences. He sees that the opportunity for social learning could strengthen study of the stated preference technique since they provide information on both consumer and citizen choice. As researchers begin to combine the stated preference techniques with deliberative decision-making tools such as focus group or citizen's jury, the outcome of deliberation depend more on the public interest than on the addition of individual utilities. This emphasis on deliberative and discursive processes of collective choice draws inspiration from various political and sociological studies, including Habermas's (1984, 1992) theory of communication.

As the role of public interest in individual valuation is increasingly being recognized, studies are beginning to address how individual preferences change and how the social valuation function is constructed through communication. Slovic (1995) and Vatn (2004) assert that the values people hold regarding matters of public policy are sensitive to change. Recent studies by

Álvarez-Farizo and Hanley (2006) and Álvalez-Farizo et al. (2007) examine the relation between social and individual preference through a series of small group discussion on water resource management. These authors find that moving from an individual to a collective choice produces among “non-selfish” respondents an increase in the willingness to pay (WTP). Howarth and Wilson (2006) investigate the theoretical relationship between collective and individual WTP under the deliberative settings. They show that group WTP for an environmental project will systematically differ from the sum of individual net benefits unless the project is financed through the Lindahl mechanism. These results are highly important for the viewpoint of our study since they suggest that decision-making process can change both the individual preferences and the resulting collective choices.

Studies conducted by Álvalez-Farizo and Hanley (2006), and Howarth and Wilson (2006) assume a consensus rule as a means of reaching collective decision-making. Social theorists in the context of liberal democracy, also presume that mutual agreement is a better way to reach a social decision than majority-rule voting (Rawls, 1971; Buchanan, 1977; Binmore, 1998).

Emphasizing the possibility of changing preferences as a result of deliberation, Dryzek (2000, pp.38–47) points to two characteristics of collective

decision-making based on communication as compared to mere voting. First, deliberation can promote awareness of the several dimensions of collective choice at issue. Alternatives can be sought for each of the dimensions; thus, collectively preferred options on each dimension aggregated into an overall choice, and through such a process there is less possibility of instability and arbitrariness. Deliberation can multiply dimensions and options, and it would seem to add to the complexity of choice; however, complexity should not be regarded as intractability since it increases the possibilities for stable and non-arbitrary agreements.

Second, deliberation has an endogenous mechanism to restrict the domain that aggregation does not have. This is important because, if the “unrestricted domain” condition of Arrow’s impossibility theorem (1951) is relaxed, then the result does not hold. Deliberation in inducing reflection on preferences and requiring that they be defended publicly eliminates preference orderings, which cannot be so defended.

At the appropriate time, something must be decided upon and some kind of option should be chosen. Regardless of the recommendation made by liberal democratic theorists, consensus can be time-consuming and costly; therefore decision-makers might be interested in using further simplified decision-making

rules such as majority voting. On the other hand, the use of majority voting may undermine democratic process, and therefore result in the participants in the discussion feeling dissatisfied with the results of collective choice.

This paper compares these two decision-making rules by identifying the divergence of group decisions from individual decisions, and by investigating the degree of satisfaction with the group decision. The purpose of the study is to empirically understand the relative performance of alternative rules in participatory processes. The stated preference technique is used as a tool for capturing individual and group preferences as well as the disparity between them.

There are a few theoretical studies and virtually no empirical studies concerning the comparison between consensus-based decision-making and majority voting. Buchanan and Tullock (1962) argue that in the absence of "decision-making costs," the unanimity rule is socially optimal. In contrast, Guttman (1998) shows that the unanimity rule is suboptimal, and a simple majority rule is found to be socially optimal when efficiency and stability are used as the criteria for evaluation.

3. Survey

3.1. Background

Our case study uses an example of the nature restoration plan in Kushiro wetland, Japan. This plan is based on the Law for the Promotion of Nature Restoration implemented in January 2003. The law requires the conductor of the restoration plan to form a Nature Restoration Committee (NRC) with local governments, governmental agencies, and other parties, including local residents and nonprofit organizations that intend to participate in the plan. NRCs, under the Nature Restoration Law, can be regarded as an attempt to reflect citizens' preferences about the public projects that can have various impacts on the environment. The distinguishing feature of the Nature Restoration Law lies in the practice of adaptive management. The conductor of the restoration evaluates the impact of projects by monitoring with state-of-the-art scientific knowledge. Moreover, if the expected results are not produced, the conductor should modify the contents of the projects.

The Kushiro wetland is well known as the largest wetland in Japan, and was registered with the Ramsar Convention in 1980. Although the area was 245.7 km^2 in 1947, its size has gradually diminished to 175.7 km^2 in 2004, which implies that 19% has been lost. The Kushiro wetland has been stressed by the increase of sand flow into the central area, mainly due to human activity from

agricultural, industrial and residential uses. The percentage of wetland area that is covered with alder stand has increased from 9% in 1947 to 46% in 2004.

As of March 2008, five nature restoration projects will be conducted to prevent sand flow into the wetland. The Kushiro Wetland Nature Restoration Committee (KWNRC) is composed of 127 members and has several subcommittees; this committee has held meetings over fifty times since its establishment. Since the membership of the KWNRC is large, the subcommittees mainly conduct detailed discussions on the projects. Conflicts between stakeholders are partly resolved through discussions in the subcommittees, such as one suggested restoration project (restoration of the meandering stream from a straightened river), which was opposed by an environmental group on account of creating severe stress to the current ecosystem of the wetland. Although agricultural waste plays a significant role in the deterioration of the Kushiro wetland, the regulation on agricultural activity has not yet been included in the nature restoration plan. The succeeding section, 3.2, explains the procedure of the experiment, and the details of the survey are given in section 3.3.

3.2. The experiment of collective decision-making

In September 2007, a market research company recruited candidates to

participate in a study to be conducted among the residents of Kushiro City. As a prerequisite, the participants were asked to respond to an SC survey at home and then bring the survey with them on the day of the experiment. We refer to this take-home survey as “Questionnaire 0.”

The experiment was held at a community center in Kushiro City, and the procedure was comprised of the three sessions, and thirty-six of the recruited candidates were participants in our experiments.

In the first session, the participants were assembled in a room and learned about the nature of restoration projects in the Kushiro wetland, and were briefed by the facilitator about the experimental procedure. Throughout the experiment, the role of facilitator was restricted to providing objective information and explaining the procedure of the survey. The information that was made available on nature restoration in the first session was also included in Questionnaire 0. Therefore, the respondents could refer to the material as supplemental information throughout the experiment. After a presentation by the facilitator, time was allocated to the participants for questions and answers. These procedures took less than twenty minutes. At the end of the session, the participants responded individually to Questionnaire 1 that contained the SC survey, wherein they selected the most preferable nature restoration plan from

three alternatives.

In the second session, the participants were divided into six groups, each consisting of six people, and each group was directed to a separate room. The consensus rule was assigned to three of the six groups, while the majority rule was assigned to the other three groups. The facilitators appointed to each group explained to their respective groups what is entailed in the assignment of a decision-making rule and the procedure of group decision-making. Subsequent, the participants were allowed to freely discuss the proposed nature restoration plan. The issues that arose in the group discussion pertained to, for instance, the expression of doubts or agreement concerning each project, concerns regarding the cost of implementing the restoration plan, and the intention to preserve the natural state of environment for future generations. The discussion continued for about twenty minutes and at the end of the second session, the participants responded individually to the SC survey, Questionnaire 2.

In the third session, collective decision-making was implemented. They responded to the SC survey collectively, depending on the rule that was assigned to each group. In the groups that were assigned the majority rule, the facilitator proposed three alternative plans sequentially, and the members of the group raised their hands when their favorite plan was suggested. In groups that were

assigned the consensus rule, the facilitator selected a member by casting the dice, and the member who was chosen proposed her most preferred plan. Subsequent, the members of the group discussed among themselves until they arrived at a consensus on the plan that they considered to be the best. They would skip the consensus-building process in cases in which they were unable to arrive at a consensus on a choice sets within three minutes, and attempt the process again after a consensus on all other choice sets.

The collective choice data was treated as though all group members chose the same alternatives in group decisions. At the same time, the data on the preferred alternatives of individuals was also tracked in both majority- and consensus-rule groups. At the end of the third session, the respondents participated in a survey that asked them to rate the degree of satisfaction they derived from the collective decision and provide general feedback on the experiment.

3.3. Design of the stated choice survey

Each questionnaire to which the participants responded individually contained the SC survey (Louviere et al., 2000). We considered three projects as attributes in a choice set of the SC: (i) the *setting and managing of a sedimentation pond*, (ii) the *restoration of the meandering stream from a straightened river*, and (iii)

the *restoration and maintaining of forests.* These attributes have already been planned for implementation by the KWNRC, and it is expected that the present plan will achieve 24% of the projected reduction in sand flow.

The *settling and managing of a sedimentation pond* is the project concerned with settling the sand contained in the agriculture drainage before the water flows into the river. The Kushiro River carries sand from the catchments to the central area of the wetland, so *the restoration of the meandering stream project* has been implemented in order to store the sand in the area outside the wetland and the *restoration and management of forests project* is expected to enhance the water retention capacity of the forests.

The attributes in the profile contain a status quo level that will be attained through the present plan, and we assumed that all the levels of attributes in this plan are uniformly 8%, for purposes of simplification. The total amount of the reduction in sand flow by the present plan will be 24%. Table 1 demonstrates the attributes and levels used in the SC survey. The numbers in the table indicate a ratio of the quantity of the sand that is prevented from reaching the central area to the total sand inflow to the area. In order to infer the participants' willingness to pay, an additional tax that is required to implement a hypothetical plan for restoration is included as the fourth attribute. It is assumed that the tax will be

levied annually for ten years.

Table 1–Wetland restoration attributes and levels used in the SC

An example of a choice set used in the questionnaires has been shown in Table 2. We developed 125 choice sets by using an orthogonal array method. These choice sets were randomly assigned to all participants throughout all sessions, except for the group decision in which participants share the same choice set within a group. The questionnaire is comprised of information about the nature restoration projects, nine stated choice questions, and queries on sociodemographic characteristics.

Table 2–An example of choice set

Respondents chose the most preferred plan from among three alternatives. Plan 1 and Plan 2 are hypothetical sets of projects that require an additional tax to be paid. The present plan implies the status quo; thus, the additional tax is zero, and therefore, no additional project will be conducted.

The respondents' choices between each alternative are analyzed using a

conditional logit model. We assume a utility function $U_{ni} = V_{ni} + \varepsilon_{ni}$, where V_{ni} is the observable utility when individual *n* chooses alternative *i*, and where ε_{ni} is the stochastic component of utility. A linear model is assumed for V_{ni} as equation (1). Here, *POND*, *RIVER*, and *FOREST* indicate the percentage of sand flow that each project prevents, and ASC_i is an alternative specific constant reflecting the effect of choosing a virtual plan regardless of the attributes. *COST* is the amount of additional tax payment. Assuming that the random component of utility is distributed as type-I extreme value distribution, the probability of an alternative that individual *n* chooses can be expressed as equation (2), where λ is a scale parameter.

$$V_{ni} = ASC_i + \beta_1 POND_i + \beta_2 RIVER_i + \beta_3 FOREST_i + \beta_4 COST_i \quad (1)$$

$$P_{ni}(U_{ni} > U_{nj}, \forall i \neq j) = \frac{\exp\{\lambda V_{ni}\}}{\sum_j \exp\{\lambda V_{nj}\}} \quad . \quad (2)$$

4. Results

The estimation results are given in Tables 3 (majority-rule group) and 4 (consensus-rule group). The marginal willingness to pay ($MWTP_k$) is computable as $MWTP_k = -\beta_k / \beta_4$, where β_k is the estimated parameter of marginal utility of each project. The data on group decision is created as if all

the members within a group chose the same alternative.

With regard to the majority-rule groups (Table 3), the coefficient of *COST* variables is significant through the entire session. Thus, it makes sense to consider the cost attributes in decision-making based on individual and collective preferences. The participants evaluated the meandering stream project (*RIVER*) the highest and the sedimentation pond (*POND*) the lowest in *Questionnaire* 0. Although *POND* is not significant in *Questionnaire* 0, it changes to a significantly negative value in the *Collective Choice*. As the session proceeded, the valuation for the *RIVER* changed from the highest to the second highest and that of the *FOREST* changed from the second highest to the highest. Alternative Specific Constants (*ASC*s) are significant throughout the entire session. The result implies that the participants prefer not to choose the status quo and do something regardless of the level of attributes.

With regard to the consensus-rule groups (Table 4), the result in *Questionnaire* 0 is similar to that of the majority-rule groups. The participants evaluated the meandering stream project (*RIVER*) the highest and the sedimentation pond (*POND*) the lowest. On the other hand, *POND* is not significant, and *RIVER* is evaluated the highest in the *Collective Choice*. In contrast to the result for the majority-rule groups, *ASC*s are not significant in *Questionnaire* 2 and *Collective*

Choice.

In order to examine the impact of the presentation in session 1 and the discussions on individual preferences in session 2, we compared the estimated parameter by testing the null hypothesis: $\beta_{Questionnaire0} = \beta_{Qusestionnaire1}$, $\beta_{Questionnaire1} = \beta_{Qusestionnaire2}$, and $\beta_{Questionnaire0} = \beta_{Qusestionnaire2}$. The test statistic is the log-likelihood ratio,

$$\mathrm{LR}_{i,r} = -2\ [\ln L(\beta_{restricted}) - \ln L(\beta_i)] \quad (3)$$

which is asymptotically distributed as a chi-squared random variable with four degrees of freedom. The test statistic has a critical value of 9.49 at the 5% confidence level. Therefore, when the value of $LR_{i,j}$ exceeds 9.49, it implies that the preferences between Questionnaire *i* and Questionnaire *j* are different (Table 5).

When we compare the preference before and after the first session by testing $LR_{1,0}$ with the null hypothesis, $\beta_{Qusestionnaire1} = \beta_{Questionnaire0}$, the effect of the facilitator's presentation and question-and-answer session are significant for both the groups. On the other hand, group discussion in the second session does not affect the preference of either group.

Table 3–Estimation result of the majority-rule group

Table 4–Estimation result of the consensus-rule group

$LR_{C,1}$ and $LR_{C,2}$ shows the difference between individual preferences in each questionnaire and the preference in collective decision. When $LR_{C,1}$ is compared to $LR_{C,2}$, it is found that $LR_{C,2}$ is smaller, regardless of the decision-making rules. As all the members were required to choose only one alternative in each group decision, the result indicates that the group discussions reduced the diversity of the individual preferences and facilitated collective decision-making.

Furthermore, a comparison of the $LR_{C,2}$ between the majority-rule group and consensus-rule group shows that the significance of the difference between individual and collective decision-making is lower under the consensus than the majority rule. This means that the individual preferences are reflected as a collective choice more in a consensus rule than in a majority rule.

Table 5–Test of the log-likelihood ratio

5. Satisfaction with collective choice

To analyze the disparity in preferences between individual and group decision-making, we hypothesized that a group member will have two utility functions—individual and collective. If their individual preference is different from that of the group, they may feel dissatisfied. The level of satisfaction can be measured by the answers to the question "Were you satisfied with the results of group decision?" at four levels ("satisfied," "not quite satisfied," "unsatisfied," and "quite unsatisfied") in the last survey at the end of the third session. None of the members stated that they had been quite unsatisfied with the result of the group decision.

We investigate how a respondent feels when the group decision is different from their favorite alternative. We create two dummy variables (*UNSATISFIED* and *NQSATISFIED*) that indicate the respondents' degree of satisfaction with the collective choice situation. If a group member chooses an alternative different from that of the group decision and is not satisfied with the result, $UNSATISFIED_i$ takes the value one; otherwise, the value is zero. If a group member chooses an alternative different from that of the group decision and is

not quite satisfied (sufficiently satisfied) with the result, $NQSATISFIED_i$ takes the value one; otherwise, the value is zero. The numbers of choice sets that conclude a collective decision that conflicts with individual preferences are 34 out of 324 in the majority-rule groups, and 27 out of 318 in the consensus-rule groups. Among these choice sets, the variable *UNSATISFIED* takes the value of one for six times in the majority-rule groups and four times in the consensus-rule groups, and the number of the variable *NQSATISFIED* takes the value of one for 14 times in the majority-rule groups and 17 times in the consensus-rule groups.

We pooled data on group decisions and individual decisions, and formalized the group valuation function as follows:

$$\begin{aligned} V_{ni} &= ASC_i + \beta_1 POND_i + \beta_2 RIVER_i + \beta_3 FOREST_i \\ &+ (\beta_4 + \gamma_1 UNSATIFIED_i + \gamma_2 NQSATISFIED_i) COST_i \end{aligned} \tag{4}$$

A group decision is composed of six group members that are assumed to be voting for the same plan. In contrast, data on individual decisions is the group members' decision that they individually choose as most preferable.

Table 6 presents the results of the estimation. One major difference exists between the two decision-making rules. In the consensus rule, any individual

can express their opinion when they wish to oppose a proposal that may be approved by group decision-making. However, this does not apply to the majority rule. The *UNSATISFIED* and *NQSATISFIED* variables are not significant in groups that were assigned the consensus rule, while both variables are positive and significant in groups that were assigned the majority rule. These results suggest that individuals who were somewhat unsatisfied with results had higher individual marginal willingness to pay (MWTP) than others in the majority groups; however, this does not apply to those who were involved in the consensus groups.

Table 6–Estimation results of group decision-making

We compare the disparity in the MWTP of the individual decision to that of the group decision for the groups under the majority rule. The definition of the disparity is as follows.

$$\begin{aligned} \frac{MWTP_{UNSATISFIED}}{MWTP} &= \left(-\frac{\beta_k}{\beta_4+\gamma_1}\right)\Big/\left(-\frac{\beta_k}{\beta_4}\right) = 216.5\% \\ \frac{MWTP_{NQSATISFIED}}{MWTP} &= \left(-\frac{\beta_k}{\beta_4+\gamma_2}\right)\Big/\left(-\frac{\beta_k}{\beta_4}\right) = 166.0\% \end{aligned} \tag{5}$$

An individual who was dissatisfied with the group decision had a 216.5% disparity in MWTP between the individual decision and the group decision, while an individual who was not quite satisfied with the group decision had a 166.0% disparity. The disparity in MWTP in the group and the individual decision is larger for the member who feels less satisfied with the collective choice. This suggests that those who are less satisfied are willing to pay more than group decisions and that the group decision-making in this survey has a tendency to choose a modest alternative from the choice set.

6. Discussion and concluding remarks

Our main findings can be summarized as follows. First, the difference between the individual preferences and collective decision-making is less significant under the consensus rule than the majority rule. Second, the degree of satisfaction that the member feels with the collective choice relates to individual MWTP in the majority-rule group but not in the consensus-rule group. Thirdly, in the majority-rule group, the greater the disparity in MWTP in the group and the individual decision, the more dissatisfied the member feel.

With respect to the first point, the consensus rule is effective in providing the participating individuals with an opportunity to reach an agreement on a plan of

nature restoration. Each participant expressed their opinion until they were satisfied with the collective decision in the consensus-rule groups. However, the members of the majority-groups could not express their opinions. Consequently, the consensus rule might increase the potentiality to reflect individual preference in the collective decision-making. The result suggests that the social theorists' claim for consent-based democracy is reasonable from an empirical viewpoint. As pointed out by Dryzek (2000), a consensus rule can promote awareness of the several dimensions of collective choice at issue and restrict the domain that aggregation does not have.

The second and third findings suggest that the relationship between individual WTP and satisfaction with collective choice differs according to decision-making rules. Based on the qualitative evidence observed in the discussion session, participants in the consensus-rule group express reasons for their preferred plan, listen to others' opinions, sometimes mitigate their position, and cooperate to reach a collective choice. On the other hand, these behaviors are not that prevalent in the groups under the majority rule. Thus in the majority-rule group, the participants with higher WTP and who are keen on an active restoration plan might be dissatisfied with the modest choice that comes by voting.

Similar to the findings of Álvarez-Farizo and Hanley (2006), we also confirmed the shift from individual preferences to collective preferences. Preferences changed significantly when people were given more information and time to think. Furthermore, the announcement of decision-making rule in session 2 could influence the members' preferences, accordingly reducing the diversity of preferences, and making the collective decision easier. However, in the majority-rule group, there is a larger disparity in the MWTP between the individual and the group decision when the dissatisfaction among the participants is higher. Although permitting the members to have discussions with each other reduces the diversity of individual preferences, it is difficult to convince the participants of a collective decision when there are great disparities of MWTP between the individual and collective decision.

Although our analysis shows the potentiality of consensus rule in resolving the conflict between stakeholders, it should be noted that the restoration plan examined in this study might come under less dispute among general citizens since most of the respondents do not seem to be affected directly by the plan. The low number of unsatisfied participants also supports this prospect. Thus, our result might depend on the situation of the Kushiro wetland in cases where the conflicts between participants are moderate. It would be interesting to apply this

methodology to a case involving more conflict and examine how the result would change when stakeholders might be more seriously affected by the restoration plan. For example, the regulation of agricultural waste would improve the situation of the Kushiro wetland, and even its inclusion into the restoration plan would invoke strong opposition by people from the agricultural sector. On the other hand, participants might agree with environmental groups' opposition to a river restoration plan, if detailed information about their concern were included in the questionnaire.

Our result highlights the usefulness of a stated preference survey to investigate the function of different decision-making mechanisms in deliberative decision-making. Further research is required to understand how a broader range of decision-making rules applies to various situations. Using the term "values jury," Brown et al. (1995) suggest that it is important to ask which decision-making rules work better with different jury tasks and different numbers of jurors, and as to what is the stability of jury judgments (e.g., how much do jurors vary across different juries). The quantitative assessment with a stated preference survey will aid in such investigations.

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Tables

Table 1 - Wetland restoration attributes and levels used in the SC					
Attribute	Level of each attribute				
Sedimentation Pond	8%	10%	12%	14%	16%
Meandering Stream	8%	10%	12%	14%	16%
Forest Restoration	8%	10%	12%	14%	16%
Additional Tax (Yen/year)	0	500	1000	2000	5000

Table 2 - An example of a choice set			
	Plan 1	Plan 2	Present plan
Sedimentation Pond	8%	14%	8%
Meandering Stream	14%	8%	8%
Forest Restoration	14%	14%	8%
Additional Tax (Yen/year)	1000	2000	0

Table 3 - Estimation results of the majority rule group									
Variable		Questionnaire 0		Questionnaire 1		Questionnaire 2		Collective Choice	
POND	Coefficient	–6.55E-02		–6.06E-02		–9.18E-02	*	–2.23E-01	***
	[St.Er.]	[5.30E-02]		[4.85E-02]		[5.09E-02]		[7.29E-02]	
RIVER	Coefficient	1.42E-01	**	1.04E-01	*	4.24E-02		7.65E-02	
	[St.Er.]	[5.96E-02]		[5.38E-02]		[5.34E-02]		[7.21E-02]	
FOREST	Coefficient	1.32E-01	**	8.79E-02		1.17E-01	**	3.13E-01	***
	[St.Er.]	[6.24E-02]		[5.37E-02]		[4.99E-02]		[7.88E-02]	
COST	Coefficient	–1.07E-03	***	–6.73E-04	***	–8.97E-04	***	–1.80E-03	***
	[St.Er.]	[1.64E-04]		[1.07E-04]		[1.36E-04]		[3.05E-04]	
ASC_1	Coefficient	1.943	***	1.597	***	2.087	***	2.133	***
	[St.Er.]	[5.21E-01]		[4.68E-01]		[4.71E-01]		[6.69E-01]	
ASC_2	Coefficient	1.915	***	1.367	***	1.714	***	2.307	***
	[St.Er.]	[5.24E-01]		[4.74E-01]		[4.82E-01]		[6.75E-01]	
Num. of obs.		162		162		162		162	
Log likelihood		–112.957		–133.187		–121.875		–80.825	
McFadden's R^2		0.365		0.252		0.315		0.546	

***p<1%, **p<5%, *p<10%.

Table 4 - Estimation result of the consensus rule group									
Variable		Questionnaire 0		Questionnaire 1		Questionnaire 2		Collective Choice	
POND	Coefficient	–1.73E-01	***	2.79E-02		5.87E-02		–3.30E-02	
	[St.Er.]	[5.13E-02]		[4.41E-02]		[4.83E-02]		[5.57E-02]	
RIVER	Coefficient	2.87E-02		5.21E-02		8.76E-02		2.25E-01	***
	[St.Er.]	[5.33E-02]		[4.84E-02]		[5.42E-02]		[7.24E-02]	
FOREST	Coefficient	1.38E-01	***	1.63E-01	***	1.67E-01	***	1.37E-01	**
	[St.Er.]	[4.94E-02]		[4.76E-02]		[5.30E-02]		[6.22E-02]	
COST	Coefficient	–5.42E-04	***	–5.41E-04	***	–6.98E-04	***	–9.06E-04	***
	[St.Er.]	[9.95E-05]		[9.71E-05]		[1.18E-04]		[1.46E-04]	
ASC_1	Coefficient	1.298	***	6.88E-01	***	4.30E-01		6.52E-01	
	[St.Er.]	[4.43E-01]		[4.07E-01]		[4.43E-01]		[5.46E-01]	
ASC_2	Coefficient	1.397	***	5.55E-01		1.58E-01		6.13E-01	
	[St.Er.]	[4.57E-01]		[4.17E-01]		[4.64E-01]		[5.74E-01]	
Num. of obs.		162		162		162		156	
Log likelihood		–140.047		–145.552		–140.111		–115.11	
McFadden's R^2		0.213		0.182		0.213		0.328	

***p<1%, **p<5%.

Table 5 - Test of the Log-likelihood ratio		
	Majority rule group	Consensus rule group
$LR_{1,0}$	11.69	22.66
$LR_{2,1}$	6.66	5.63
$LR_{2,0}$	7.72	29.45
$LR_{C,0}$	31.78	29.58
$LR_{C,1}$	53.03	18.86
$LR_{C,2}$	37.5	9.98

$LR_{i,r} = -2\ [\ln L(\beta_{restricted}) - \ln L(\beta_i)]$, where $\beta_{restricted}$ is the restricted parameter vector and β_i is the unrestricted parameter vector.

Table 6 Estimation result of group decision-making

	Majority rule group			Consensus rule group		
Variable	Coefficient		St.Er.	Coefficient		St.Er.
POND	–1.519E-01	***	4.619E-02	–3.328E-02		3.868E-02
RIVER	5.499E-02		4.607E-02	1.768E-01	***	5.026E-02
FOREST	2.808E-01	***	4.818E-02	1.576E-01	***	4.580E-02
COST	–1.366E-03	***	1.712E-04	–1.009E-03	***	1.149E-04
NQSATISFIED*COST	5.431E-04	**	2.750E-04	–6.620E-04		5.276E-04
UNSATISFIED*COST	7.351E-04	**	3.728E-04	4.444E-04		4.143E-04
ASC_1	1.429	***	4.109E-01	0.845	***	3.718E-01
ASC_2	1.548	***	4.116E-01	1.014	***	3.888E-01
Num of obs	324			318		
Log likelihood	–195.709			–235.3974		
McFadden's R^2	0.450			0.3262		

***p<1%, **p<5%.