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People's Awareness to River Improvement Projects with Planning of Dam Construction for the Kitagawa River, Fukui Prefecture

T. Hosoda
Dept. of Urban Management, Kyoto University, Kyoto, Japan
hosoda.takashi.4w@kyoto-u.ac.jp

T. Kazusa & K. Ohara
The former Master Course student, Dept. of Urban Management, Kyoto University, Kyoto, Japan

ABSTRACT:
This paper describes the results of the questionnaire to survey the people's awareness to the river improvement projects with the planning of dam construction (the Kouchigawa Dam) for the Kitagawa river running in Obama City and Wakasa Town, Fukui Prefecture. Three categories of Flood Control, Water Supply for irrigation, industries & tap water and Natural Environment Conservation ware considered as the objectives of river improvement projects. CVM and Conjoint Analysis were applied for the quantitative evaluation of people's awareness to each project for flood control, water supply and natural environment conservation in the river basin. Approval, neutral or disapproval to the dam construction was also questioned with the evaluation of the willingness to pay (WTP). WTPs evaluated using payment card method for each of three objectives are flood control: 2,324(yen), water utilization: 2,098(yen), natural environment conservation: 1,845(yen) and the Kouchigawa dam construction: 1,342(yen), showing the large differences between Obama City and Wakasa Town.

Keywords: river improvement works, questionnaire investigation, people's awareness, CVM , Conjoint Analysis

1. INTRODUCTION

This paper describes the results of the questionnaire to survey the people's awareness to the river improvement projects with the planning of dam construction (the Kouchigawa Dam) for the Kitagawa river running in the Wakasa-Resion of the Fukui Prefecture.

The Kitagawa River rises in Mt. Sanjyu-Sangen near the border of Fukui and Shiga Prefectures as shown in Fig. 1. The river runs toward the north-west, joining the Kouchigawa River, Toba River and Sugiyama River in Wakasa Town and the Nogi River and Onyu River in Obama City, and then discharges into Obama Bay. The basin area of the river is 210.2 km^2 and the length is 30.3 km. 83% of the basin is mountainous area, 13% agricultural land and 4% residential area.

Although the river is categorized as Class-A river, which is managed by National Government, the Fukui Pref. is commissioned to manage the upstream part of the main river course and the tributaries. Dam construction (Kouchigawa Dam) with multi-purposes has been planned by Fukui Pref. since early times.

Three categories of Flood Control, Water Supply for irrigation, industries & tap water and Natural Environment Conservation were considered as the objectives of river improvement projects. CVM [Kuriyama (1998, 2000)] and Conjoint Analysis [Louviere (1994)] were applied to evaluate the people's awareness to each project for flood control, water supply and natural environment conservation in the river basin. Approval, Neutral or Disapproval to the dam

Figure 1. The Kitagawa River Basin

construction was also questioned with the evaluation of the willingness to pay (WTP).

2. OUTLINE OF QUESTIONNAIRE SURVEY

The general questions including age, occupation, annual income, the number of times to visit the river, attraction of the river, etc. were put at the beginning of the questionnaire sheet. The part of CVM is followed after the general questions. WTPs for the flood control project, the water supply project, the natural environment conservation project and the Kouchigawa dam construction were questioned as the additional tax payment in future 20 years using double-bounded dichotomous choice method (DBDM), payment card method (PCM) and multiple-bounded discrete choice method (MBDCM). DBDM becomes the most popular method since NOAA recommended to use in the guideline. On the other hand, Welsh and Poe (1998) showed the WTP evaluated by DBDM is close to 'Not Sure Level' of MBDCM, and PCM is close to 'Probably Yes Level' of MBDCM. In this study, three methods were applied to make sure of the results by Welsh and Poe.

Questions of Conjoint Analysis with choice experiment are followed after the part of CVM. In the same way as CVM, the flood control project, the water supply project, the natural environment conservation project and the payment were considered as four attributes. The maximum level of each category is the same as the project level used in the part of CVM. 15 profiles were prepared by combining 3 attributes and payment with a few levels. 3 profiles among 15 profiles were used to make one card with one present state, and then 5 cards were presented to each respondent.

1404 questionnaires were distributed to residents in the river basin directly in December, 2009 and answer sheets were returned by mail. The percentage of reply is 23.4% (=329/1404) and the average age is 59.5.

2.1. Results of CVM

Regarding flood control, the following project was presented, and then each respondent was asked to answer WTP.

[Flood Control]
Objectives: Flood control projects to protect flood vulnerable area from 100 year precipitation
Current situation: The colored area shown in Fig. 2 has high possibilities to be inundated based on the flood hazard map.
Result: Flood vulnerable area is protected from inundation for 100 year precipitation.

Before questioning WTP using double-bounded dichotomous choice method, payment card method and

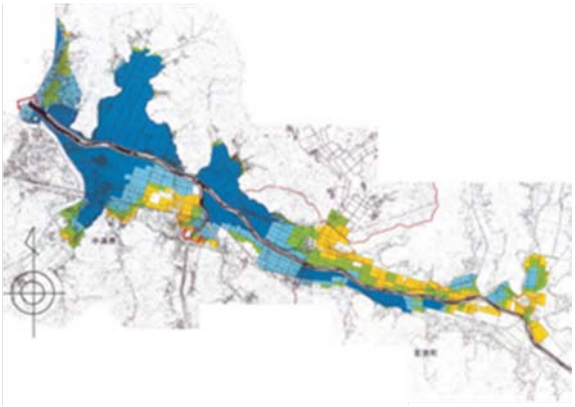

Figure 2. Flood hazard map by MLIT

Table 1. Medium of WTP (Unit:Yen)

	Double-bounded dichotomous choice	Payment Card	Multiple-bounded discrete choice			
			Definitely Yes	Probably Yes	Not Sure	Probably No
Flood Defense	3,267	2,324	1,941	2,783	4,207	9,395
Water Supply	2,433	2,098	1,231	1,926	3,376	5,848
Environment Conservation	2,832	1,845	1,279	1,973	3,264	6,019
Dam Construction	1,173	1,342	688	1,047	2,088	3,202

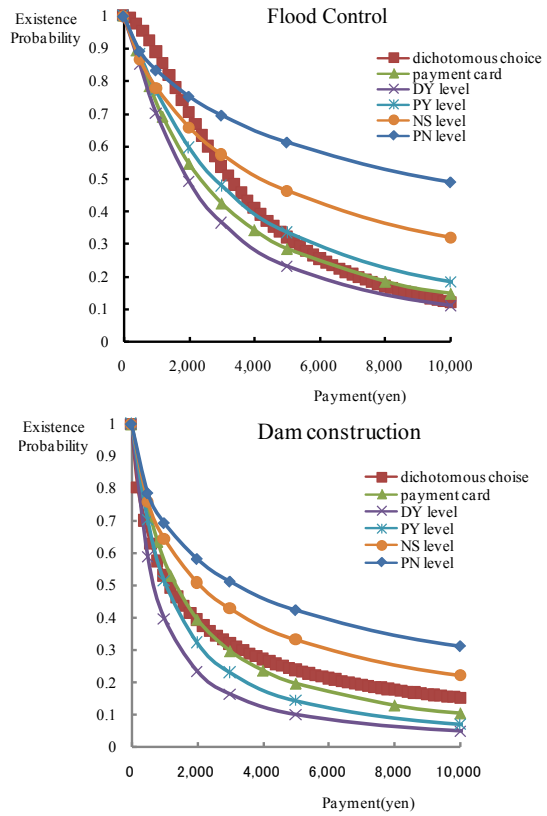

Figure 3. Existence probability of Yes

multiple-bounded discrete choice method, Approval, Neutral or Disapproval to the project was asked to divide the respondents to groups for Conjoint Analysis.

Regarding water supply, natural environment conservation and dam construction, the similar explanation of each project was presented to each respondent.

Some results of CVM based on each method are shown in Fig. 3 and Table 1. Fig. 3 shows the existence probability of people that WTP doesn't exceed the amount of the abscissa.

Table 1 shows the medium of WTPs evaluated by double-bounded dichotomous choice method, payment card method and multiple-bounded discrete choice method. WTPs of double-bounded dichotomous choice method are larger than ones of payment card method except dam construction. WTPs of payment card is nearly the same as WTP of Probably Yes level. WTP of dam construction is relatively small compared to the other WTPs.

Table 2 shows the ratio of Approval, Neutral and Disapproval to each project. Although the ratios of Approval to Flood Control, Water Supply and Environment Conservation are more than half the number of respondents, the ratio of approval to Dam Construction is about 30% and the ratio of disapproval 16%. Although the demand for the progress of flood control project is relatively strong, people in the river basin seem not to understand the necessity of dam construction fully.

Table 2. Ratio of Approval, Neutral and Disapproval to each project (Unit:Yen)

	Flood Defense	Water Supply	Environment Conservation	Dam Construction
Approval	58.9%	50.7%	60.4%	29.6%
Neutral	24.4	35.2	29.3	46.7
Disapproval	8.1	8.9	5.9	15.9
No Answer	8.5	5.2	4.4	7.8

Table 3. Marginal WTPs to each project (Unit:Yen)

Flood Defense (important)	23,220
Flood Defense (not important)	-2,562
Water Supply	376
Plant in Marsh Area (Hangesho)	-2,454
Japanese River Trout (important)	42,887
Japanese River Trout (not important)	17,817

Flood Defense	2,764
Water Supply	376
Plant in Marsh Area (Hangesho)	-2,454
Japanese River Trout	20,171

2.2. Results of Conjoint Analysis

Conjoint Analysis was also applied to survey the people's awareness to the river improvement projects and to compare the results of Conjoint Analysis to ones of CVM. An example of the questionnaire is shown in Fig. 4.

The following linear equation (1) was used as the utility function to evaluate Marginal Willingness To Pay (MWTP) to each project.

$$U = \beta_{\text{payment}} x_{\text{payment}} + \beta_{\text{flood}} x_{\text{flood(important)}} + \beta_{\text{flood}} x_{\text{flood(not important)}} + \beta_{\text{water supply}} x_{\text{water supply}} + \beta_{\text{plant in marsh}} x_{\text{plant in marsh}} + \beta_{\text{trout}} x_{\text{trout(important)}} + \beta_{\text{trout}} x_{\text{trout(not important)}} + \varepsilon \quad (1)$$

where U ; utility function, x : levels for each project, β ; coefficients, ε ; random fluctuations.

Q16-1 If the plans on the improvement projects in the Kitagawa River are presented described below, would you choose the most agreeable plan and the next agreeable plan.

	Plan1	Plan 2	Plan 3	Present State (No projects)
Level of Flood Defense	100 year	100 year	30 year	12 year (present state)
Frequency of Drought	30 year	5 year (present state)	5 year (present state)	5 year (present state)
Environment Conservation	An endangered plant in marsh areas such as Hangesho Japanese river trout	No projects (present state)	An endangered plant in marsh areas such as Hangesho Japanese river trout	No projects (present state)
Payment for each household as an annual additional tax in future 20 years	10000 yen	3000 yen	5000 yen	0 yen

Would you mark ⬭ on the most agreeable plan. (Plan 1, Plan 2, Plan 3, Plan 4)
Would you mark ⬭ on the second agreeable plan. (Plan 1, Plan 2, Plan 3, Plan 4)

Figure 4. Example of the Card with 4 profiles and 4 attributes for Conjoint Analysis

Marginal WTPs are shown in Table 3. MWTP for Flood Control (2764yen) shown in the lower table of Table 3 is roughly the same as WTP of CVM (2324yen) in Table 1. But MWTP for Water Supply (376yen) in Table 3 is much less than WTP of CVM (2098yen) in Table 1.

Table 4 shows MWTPs of people in Obama City and Wakasa Town separately. MWTP on Flood Control of people in Obama City is much larger than one in Wakasa Town, but MWTP on Water Supply in Obama City is much less than one in Wakasa Town. These results reflect that many people in Obama City are protected by the levee system from floods. On the other hand, some people possessing farm land in Wakasa Town have been demanding water for irrigation newly produced by dam construction for a long time. We couldn't detect these clear differences in the results obtained by CVM.

2.3. Considerations on Dam Construction

Table 5 shows WTPs of people expressing Approval, Neutral and Disapproval for Dam Construction separately. Regarding people expressing Approval, WTP of Dam Construction by CVM is almost the same as one of Flood Control and Water Supply. People with Disapproval have relatively large WTP for Flood Control and Water Supply compared to WTP of Dam Construction which is almost zero. These people seem to demand the improvement projects without Dam Construction. MWTPs by Conjoint Analysis change largely among people expressing Approval, Neutral and Disapproval compared to the results of CVM, although further investigation is needed to understand the relation between the results of CVM and Conjoint Analysis.

Table 4. MWTPs of people in Obama City and Wakasa Town (Unit:Yen)

	Obama City	Wakasa Town
Flood Defence	3,183	-431
Water Supply	-687	3,007
Plant in Marsh Area	-3,193	-1,034
Japanese River Trout	21,131	17,428

Table 5. WTPs of people expressing Approval, Neutral and Disapproval for Dam Construction (Unit:Yen)

(a) Double-bounded dichotomous choice (CVM)

	Approval	Neutral	Disapproval
Flood Defense	3,897	2,922	2,928
Water Supply	3,645	2,303	896
Environment Conservation	3,742	2,302	2,441
Dam Construction	4,154	1,133	

(b) Payment Card (CVM)

	Approval	Neutral	Disapproval
Flood Defense	3,339	2,386	1,592
Water Supply	3,057	2,152	1,307
Environment Conservation	1,503	2,086	1,884
Dam Construction	3,417	1,250	96

(c) Conjoint Analysis

	Approval	Neutral	Disapproval
Flood Defense	7,488	1,683	423
Water Supply	4,874	1,005	-1,601
Environment Conservation	1,063	-3,619	963
Dam Construction	30,295	17,031	17,235

3. CONCLUSIONS

This paper describes the results of the questionnaire to survey the people's awareness to the river improvement projects with the planning of dam construction for the Kitagawa river.

The results obtained through the examination of the questionnaire investigation are summarized as follows:

a. WTPs evaluated using payment card method for each objective are Flood Defense: 2,324(yen), Water Supply: 2,098(yen), Natural Environment Conservation: 1,845(yen) and Kouchigawa Dam Construction: 1,342(yen). These amount of payment are equivalent to Definitely Yes Level of multiple bounded discrete choice method.

b. People in Obama City think much of Flood Defense compared to Water Supply, but people in Wakasa Town attach importance to Water Supply for irrigation.

c. Regarding dam construction, the percentage of Approval is 30%, Neutral 47% and Disapproval 16%. This results indicate that the section in charge of river management with dam construction should make efforts to build high consensus for dam construction.

d. Marginal WTPs obtained using Conjoint Analysis change largely with objectives and among people expressing Approval, Neutral and Disapproval compared to the results of CVM. Although the results of Conjoint Analysis seem to be highly sensitive to people's awareness, further investigation is needed to understand the relation between MWTP by Conjoint Analysis and WTP by CVM.

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