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HOLISTIC LANDSCAPE PLANNING`S VALUE FOR NATURAL DISASTER RECONSTRUCTION: WILLINGNESS TO PAY FOR NEW RESIDENCE IN DIFFERENT RECONSTRUCTION PLANNING APPROACHES

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ABSTRACT: Practical evidence demonstrating the effectiveness of holistic landscape planning is limited because comprehensive decision-making is misunderstood as depriving individual sectors' authority and budgets. The author compared two municipalities' difference of recovery speed and the quality of relocation housing; Shinchi town and Soma city, which are this project subjects, had contrasting planning processes from 2011 Japan Earthquake and Tsunami disaster. Shinch town has recovered by bottom-up the planning process and the author's natural disaster risk analysis, which based on 1969's McHarg's landscape planning principle. Whereas, Soma city has recovered by the top-down planning process, which was the same method as other municipalities affected by the tsunami. In this test, 263 students evaluated relocation houses' prices without any information about differences of the planning process. The author analyzed subjects' attribute data that could potentially affect their evaluation: sex, the environment in childhood, etc. T-test and multiple regression analysis were performed to evaluate the effects of differences of the planning process for the value of the house. Welch's T-test found the mean of relocation residential WTP ($). Shinchi town's house (mean=$185400) was significantly higher than that of Soma city (mean=$157680. t=15.9, p<2.2e-16 (two-tailed), d.f.=3622.1), $1=￥100). Multiple linear regression was calculated to predict [WTP], based on [USP : Under Shinchi town planning process] and [VDD : Volunteer or donation to a disaster area]. (Predicted WTP is equal to [150200] + [+27700] ([USP]) + [+8176] ([VDD]). [USP] is coded as [Shinchi:1 or Soma:0], and [VDD] is coded as [Yes:1, No:0].). These findings can help us in recovery planning from disasters.

Keywords: 2011 Japan earthquake and tsunami disaster, Reconstruction. Cost-benefit, Climate-change

1. INTRODUCTION

Amendola [1] indicated that between 1984 and 2003, more than 4 billion people were affected by extreme natural events and that between 1990 and 1999, the cost of natural disasters was more than 15 times higher than during 1950-1959 [2]. This research noticed that although there had been some progress toward integrated and proactive risk management for disasters in many countries, the standard planning approaches to disasters were still too reactive. Moreover, in most countries, there has been little integration among the relevant responsibilities. For example, each disaster prediction sector, land use, and city planning sector are generally separate in both academic and administration. Formerly, many Japanese people had believed that modern subdivide technology could prevent damage from any natural disasters. But it was proved to be a fault by the 2011 Earthquake and Tsunami Disaster in Japan. Thus, we should change fragmentary approaches to a new holistic approach to citizen's participation. In fact, the disasters which attack our society are becoming more and more frequent and unpredictable. But unfortunately, many relocation sites after the disasters are still based on fragmentary top-down approaches.

On the other hand, in 1969 Ian L. McHarg [3] compared the cost-effectiveness of uncontrolled growth to that of controlled growth with comprehensive land use planning in Baltimore County, Maryland. On that basis, he showed that it is possible to increase development income by comprehensive land use plan. George Hundt Jr [4] analyzed actual Baltimore region development. He showed that McHarg's master plan was very effective in developing new restrictions, but McHarg's approach was unable to induce new housing development. Melissa Wagner [5] and Yang, B. [6] pointed out that McHarg's 1970's original analysis for land suitability of New York Staten, Island, and planning of The Woodlands Texas were effective to avoid disasters respectively.

Can the comprehensive planning process contribute to developing the housing whose value is higher? This question has not been clarified in

such circumstances. The aim of this present study is evaluating the real value of reconstructed housing with holistic land use planning approach in the 2011 Tohoku earthquake and tsunami disaster area.

2. METHOD

2.1 Study Area Selection

In this survey, we focused on the redevelopment housing of two municipalities in the area affected by the tsunami. These are both at Fukushima Prefecture and made plans in the contrast process. With the landscape principle of Ian McHarg and the historical data of the Japanese Army Agency in 1980, Shinchi Town provided residents with many reconstruction sites through a bottom-up planning process and site suitability analysis [7]. While the process of Shinchi Town involved public decisions with the citizens, Soma city had decided on a prompt solution without rethinking the plan. Unfortunately, in most areas affected by this disaster, rebuilding was carried out in the same way as Soma city. In the tsunami disaster areas which are larger than Shinchi Town, it is difficult to formulate a bottom-up plan with many communities of survivors. Actually, Shinchi Town's method required too much time and many people to support workshops for relocation new housing. Therefore, programs that support consultation on careful site investigation are important.

2.2 Monitoring Until The Housing Relocation Is Completed

The author analyzed the two towns' reconstruction process until the housing was completed; This section is necessary to compare each town's achievement rate of development, from the candidate site selection (2012) to close - out of recovery and reconstruction (2015).

2.3 Reconstruction Housing Evaluation By WTP

Based on the photographs of each reconstruction residential area taken in 2015, the author conducted a questionnaire survey of CVM to 263 students. Its purpose was to investigate how much we would like to pay for 14 site houses (Shinch town's 7 sites, Soma city's 7 sites). The hedonic approach deals with actual sales' price. But, it is difficult to estimate appropriate price data in this disaster recovering area, since the rebuild relocation housing construction used government subsidies. Therefore, the author decided to carry out a CVM (WTP) approach, using the virtual evaluation method instead of the houses' actual prices. The author also designed a web questionnaire which surveyed actual victims, but there is a bias to evaluate their own housing and region samples highly. Furthermore, in actual disaster areas, the young generation's outflow to the other big city is a serious problem, so the author used the university's students as subjects. In the CVM virtual evaluation method, which is generally a two-step selection method, is selected to avoid a decrease in the number of samples due to an answer of 0 yen. However, in order to have 14 sites of reconstruction houses evaluated in this research, after indicated the present average sales price (20 million yen) of the reconstructed housing at the coastal region of Fukushima, the author requested students answer the evaluation price by free description (Open -end method).

2.4 Photographing Completed Reconstruction Houses and its Processing

Photos of developed relocation houses were taken to reflect each type of houses and the surrounding environment. In addition, photos were processed to minimize temporal effects such as sky's brightness. Regarding actual price evaluation of CVM, in order to eliminate the influence of the evaluation order, this CVM test showed the subjects the photos of Shinchi town and of Soma city mutually.

2.5 Statistical Processing

Wilcoxon 's t-test and multiple regression analysis were performed to analyze the effects which holistic environmental planning process had on redevelopment houses' value. A logit model including both planning styles (Shinch or Soma) tested the significance of the related variable. An underlying factor which decides the value is the contribution of adding each variable stepwise procedure.

3. RESULT

3.1 Study Area Analysis

Since 2011, 700 billion dollars was used as the reconstruction budget in the tsunami disaster areas. But 100 thousand victims moved to another big city from the affected area until 2015, although building infrastructure and housing was promoted.

Shinchi town is the only successful model that restored the population, except for big cities. The big cities whose other population has recovered are Minami-Soma and Iwaki, which had temporary workers at Fukushima nuclear power

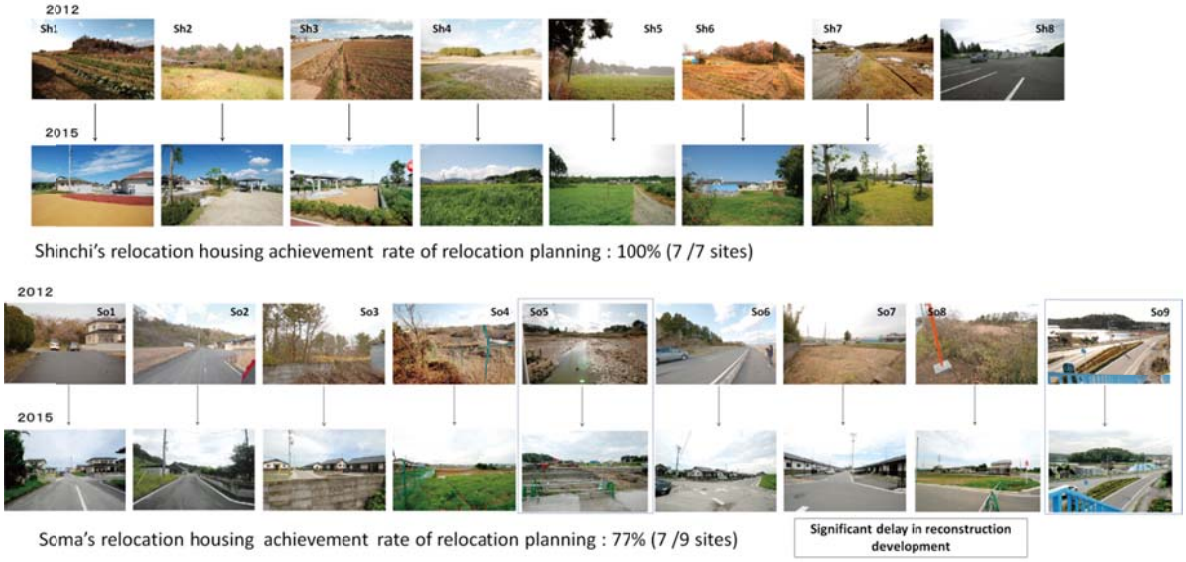

Photo 1 Difference in progress of housing relocation between Shinchi town and Soma city

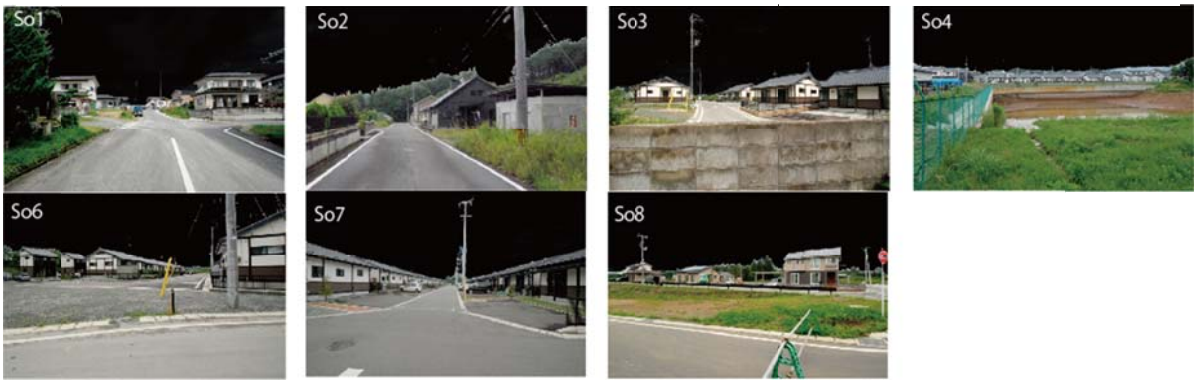

Photo 2 Shinchi town's real relocation houses in 7 sites

Photo 3 Soma city's real relocation houses in 7 sites

plant and radioactive decontamination work, and Sendai, which is the biggest city in the Tohoku region.

Shinichi town decided the policy to purchase the tsunami inundation residential area by consultation with the government. This decision was made fastest in the 2011 disaster areas. Tadayoshi Inoue helped the initial direct negotiation between Shinch town and the government, but the other municipalities had not tried any contact with the government. Shinchi town could start to decide the suitable site to rebuild houses by consultation with its residents from the whole town smoothly. On the other hand, Soma City and many other municipalities basically used the remaining place of the past city planning's residential zone, which had been decided already as the relocation's destination. These site planning had been determined before the disaster in 2011. Shinchi town's reconstruction process with residents' participation required a lot of time and effort, but the Soma city's process did not. But Soma city's

victims might have to build houses in the areas which are not suitable for development because the areas which are proper for residential zone had already been taken up by other buildings [8].

In 2011, the author evaluated the natural disaster's risk of the candidate sites for relocation housing in Shinchi town and Soma city, using 1980's Japan Land Agency's environmental data and McHarg's land evaluation process. Shinch town's housing candidate sites were decided by many design workshops with residents and the administer at 30 times per year. Interestingly, these sites coincide with the areas which are judged to be safe for flooding and earthquake, by author's comprehensive land suitability analysis. On the other hand, Soma city's sites were evaluated more dangerous than Shinch's sites.

The result of disaster risk assessment by the author was also referred to by Shinch town, and they decided the 7 relocation places in 2012.

3.2 Monitoring Housing Relocation Process

Photo 1 shows the difference between two municipalities' development achievement rate. The Shinchi town's completion rate of relocation houses has been 100% (7/7 sites) until 2015. On the other hand, that of Soma city has been 77% (7/9 sites) until 2015. Moreover, the occupancy rate of Soma city's house is also low.

3.3 Evaluation of Relocated Housing Value by WTP

Sinchi town's and Soma city's relocation houses which were evaluated were both 7 sites.

Pictures 2 and 3 show the type of each relocation housing and the surrounding environment. In the process of Shinichi Town, co-decision between citizens and the local government was involved, while Soma City decided plans for a quick solution which based on the past city planning made before the earthquake. Comparing the completed reconstruction houses of the two municipalities, Shinchi town's new houses had a lot of green space and semi-public open space. On the other hand, Soma city's ones had no space like that. Because the many remaining candidate sites are a wetland, and proper areas for residential zone had already been used.

3.3.1 Differences of two municipalities' WTP by t-test Evaluation

The difference between the mean WTP of the Shinchi town and that of Soma city was 27720 $ / house (Table 1). In addition to using Welch t-tests, we compared the two municipalities' average of the relocation house price. As a result, it was cleared that Shinchi town's WTP is higher than that of Soma city.

3.3.2 Evaluation of relocation house's WTP by multiple regression analysis

Table 1 Willingness-to-pay estimates ($1=¥100)

willingness-to-pay estimate	(1$ = ¥100)	
	Shinchi town's new house	Soma city's new house
	(Ecological Planning)	
the mean	185400.3	157680.4
standard deviation	56314.2	49591.4
95% confidence intervals	88165.4 282635.2	47263.9 268096.9
	Test satisrics	probability
Welch t-test	15.85	p < 2.2e-16

Table 2 Evaluation result of relocation house's WTP by multiple regression analysis

	All data		
	Model1		
Variable	Estimate	t value	Pr(>|t|)
Intercept	154330	30.038	< 2e-16 ***
ME:Major of Education	5035	−1.779	0.075247 .
MF:Major of Fiber Science	7046	1.764	0.077752 .
MLE: Major of law and economy	6200	2.066	0.038928 *
ML:Major of literature	6484	2.224	0.026180 *
MM:Major of Medical	−2342	−0.311	0.756
MS:Major of Science	9236	2.403	0.016322 *
ME:Major of Engineering	−4937	−1.588	0.112
USP:Under Shinchi town planning process	27720	16.157	< 2e-16 ***
GUS:Grow up in the suburbs	−786	−0.301	0.764
GUU:Grow up in the urban	−8956	−2.357	0.018454 *
GUC:Grow up in the countryside	2678	0.844	0.399
GUA:Grow up in the apartment	3503	0.802	0.423
GUD:Grow up in the detached house	−5975	−1.979	0.047883 *
DSL:Desire of suburb living	−3595	−1.370	0.171
DUL:Desire of urban living	−25314	−6.660	3.16e-11 ***
DCL:Desire of countryside living	11544	0.387	0.699
DAL:Desire of apartment living	13253	2.478	0.013248 *
DDL:Desire of detached house living	8176	2.309	0.020986 *
TTD:Traveling to a disaster area	−8980	−2.863	0.004216 **
VDD:Volunteer or donation to a disaster area	6346	3.339	0.000849 ***

This section examines the relationship among the evaluation (WTP) of the relocation housing after 2011 Tohoku earthquake disaster, the difference of planning process (Shinch's way or Soma's way), and the respondent attribute by multiple regression analysis (Table2).

Since the obtained WTP scores followed a normal distribution, analysis using that value was carried out. 269 individuals were interviewed and 263 of that were valid responses. The author did not inform the subjects of the difference of two towns' planning process and these photos' location.

Table 2 shows the analysis result of the contribution of adding each variable falling a stepwise approach. This table shows that the largest positive contribution to explain variation in WTP is USP (Under Shinchi town's planning process). The VDD (Volunteer or donation to a disaster area) also has a positive contribution to explaining variation in WTP.

4. CONCLUSION

Prior works documented the existence of farmland and green space's value [9]−[11]; for example, Mbolatiana Rambonilaza [10] reports that most of the visitors were willing to pay for the use of wooded recreation areas. Furthermore, approximate half of the respondents were willing to pay to prevent forested parks from changing to another land use, to keep the quality of their housing environment.

There are prior works which documented the relationship between the house's price and environmental factors [12], [13], [14], [15] ; For example, Fanhua Kong [13] reported that proximate urban green space (the size-distance index of forest park, accessibility to parks and green spaces) has a positive impact on houses' prices.

In addition, Ian L. McHarg [3] compared the cost-effectiveness of an uncontrolled land use development with that of a comprehensively controlled land use development, in Baltimore County, Maryland. This simulation showed the possibility to increase development revenue. George Hundt Jr [4] indicated that McHarg's Baltimore master plan did not achieve houses' development, although it was effective for controlled development. Melissa Wagner [5], and Yang, B. [6] proved the usability of the original McHarg's land use plan for natural disasters. But, actual development deviated from original McHarg's land use planning.

Thus, the purpose of this present study is to clarify that the possibility of the comprehensive planning process contributes to the development of new valuable house in disaster area reconstruction.

The candidate sites selected by Shinch town's careful bottom-up planning process correspond with the safer sites (low natural disaster risk) which was judged by author's evaluation with 1980's Japan Land Agency's data and McHarg's land analysis and planning process. Shinchi town needed a lot of time to accomplish the relocation, but the author's method has the possibility to save time.

Next, the author found that Shinchi town's relocation house's WTP is higher than Soma city's WTP statistically. In addition, multiple linear regression analysis indicates that USP (Under Shinchi town's planning process) and VDD (Volunteer or donation to a disaster area) are positive contributions. This result means that Shinchi town's process increased the mean of relocation houses' value (27,719 $ / house).

These findings extend the research results of McHarg[3], George Hundt Jr. [4], Wagner [5], and Yang, B. [6]. ; The holistic bottom-up land use planning process is useful for selection of reconstruction site and development of new valuable residence for victims in 2011 Tohoku earthquake and Tsunami disaster field.

In other words, this comparison of WTP indicates that the comprehensive planning process contributes to development of new reconstructed housing with the higher value after a disaster.

Tohoku Earthquake and Tsunami disaster had serious social damage indeed: Magnitude-9 earthquake, Tsunami disaster area 561km^2, Dead 15,894 people, missing 2,500 people, Destroyed buildings 120,000, Half-destroyed buildings 278,000. The direct financial damage by this disaster is $199 billion dollars. The damage relating to radiation effect is estimated to cost approximately 641 million dollars in Fukushima prefecture [16]. In addition, although 700 billion dollars for reconstruction expenses had been used, 100 thousand victims moved to other big cities from restoring home towns.

So it is very important that the houses which based on holistic land use planning get higher evaluation than the house by top-down planning process in Tohoku disaster areas. However, although our hypotheses were supported statistically, this paper had not enough analysis on the relationship of Shinch town and Soma city's relocation site selection and planning process. Thus, the follow-up work to compare these processes' differences should be included in the future.

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