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Article

Design Charrette as Methodology for Post-Disaster Participatory Reconstruction: Observations from a Case Study in Fukushima, Japan

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Abstract: Although there has been a growing body of literature on post-disaster participatory reconstruction, a shared understanding on a participatory approach is insufficient. A design charrette is a participatory planning that is particularly suitable for situations in which multidisciplinary professionals and non-professional stakeholders collaborate to accomplish target tasks in a short period of time. The purpose of this paper is to explore the role of design charrette as a methodology in the context of post-disaster reconstruction in Japan. This will be achieved through a participatory observation on a design charrette in Minamisoma City, Japan, after the Fukushima accident. The charrette includes the participation of multiple stakeholders in intercultural, intergenerational and interdisciplinary exchanges. The contributions and constraints of the charrette are analyzed on the basis of the authors' observation, and a strategy to improve post-disaster reconstruction charrette is thereby proposed. This study shows that the charrette is a useful method for communication and collaboration in the post-disaster context. Furthermore, it also demonstrates that assuring the participation of all key stakeholders, improving the training of participants and introducing resource analysis during the charrette's preparatory stage are the essential conditions for the legitimacy and policy compliance of the final result.

Keywords: participation reconstruction; design charrette; post-disaster; Fukushima accident

1. Introduction

Participation reconstruction has received significant attention in the literature. Among all the participants, resident participation is an important factor for post-disaster reconstruction in building a sustainable, resilient community [1–6]. A top-down approach may easily fail to recognize the complex environment of a disaster area and the unmet recovery needs of local residents [7]. Often, the top-down approach results in the dissatisfaction and resentment of the local residents, which may hinder the reconstruction progress [8]. Encouraging local residents, especially key stakeholders, to participate in reconstruction planning could achieve more effective and community-oriented long-term reconstruction solutions [9]. In addition, participation in reconstruction enables socially vulnerable groups to express their opinions in the decision-making process [10]. However, a shared understanding of the participatory approach in the post-disaster context is scant [8,11].

A design charrette is a participatory planning method that has attracted a substantial amount of attention. This method is particularly suitable for situations in which multidisciplinary professionals and non-professional stakeholders collaborate to accomplish target tasks in a short period of time [12]. The method enables the local stakeholders to become involved in the planning process and ensures that participant requests could be reflected in the final result [11]. Design charrettes have been widely applied in urban planning in North America [12,13]. However, few case studies have been researched on the application of design charrettes in post-disaster reconstruction conditions, especially in East Asia. It is necessary to share new experiences for a better understanding of the performance of a design charrette in the post-disaster context.

This study aimed to investigate the charrette as an important participatory reconstruction method during post-disaster reconstruction. This article reports a case study on collaboration between University and a local NGO (non-governmental organization), in which a design charrette was used in post-disaster reconstruction planning in Minamisoma city, Japan. Minamisoma suffered a triple disaster (an earthquake, a tsunami and a nuclear accident) in 2011, which could be a typical area for post-disaster reconstruction study. The charrette was based on geographic information system (GIS) technology and included the participation of multiple stakeholders in intercultural, intergenerational and interdisciplinary exchanges. The authors conducted an intensive observation of the entire charrette process from a participant's perspective. The contributions and constraints of the charrette were analyzed based on the observation, and a strategy to improve post-disaster reconstruction charrettes was proposed. The objective of this study is to improve the understanding of conducting a charrette approach in a post-disaster reconstruction environment. This study also describes experiences and lessons that may serve as references for future studies on the use of charrettes in post-disaster reconstruction.

2. Literature Review

Post-disaster recovery is a social process that involves policy decisions, institutional capacities and struggles between interest groups [14]. In this process, the participation of local stakeholders should play an important role. Such participation can promote understanding between residents and policy makers. It can also assist them to make democratic choices and encourage the development and the reconstruction of disaster-struck area [3,4,8,12]. If stakeholders are excluded from the decision-making

process, they are highly likely to obstruct or resist the reconstruction plan through noncooperation [8,15]. The understanding and acceptance of the reconstruction plans and policies by all stakeholders is crucial for successful post-disaster reconstruction. Therefore, the reconstruction and redevelopment of a disaster-struck area should be cautiously based on comprehensive and continuous communication with all stakeholders [3]. However, currently, there are few case studies that find evidence of a sufficient participation of stakeholders in post-disaster reconstruction [8,12]. In Japan, although governments have adopted measures to encourage the communication between policy maker and local residents (e.g., funding NGOs to participate in post-disaster reconstruction), these efforts have been primarily concentrated on enhancing community cohesion [6]. Governments primarily focus on policy explanation and opinion collection but often fail to enable residents to truly participate in decision-making. During the process of policy execution, the lack of effective participation is usually followed by a slow recovery progress that occurs because of the failure to obtain the understanding and support of local residents [6,16,17].

Although the charrette has become increasingly popular in urban planning, it has been rarely used in the post-disaster reconstruction context [11]. In the 19th century, the term "charrette" was first used to describe the activity of students in art or architecture departments who joined together to finish their assignments as their deadlines approached [18,19]. The charrette represents a major example of the intensive design work session with a collaborative public workshop. A charrette is suitable for intensive and space-oriented situations. Such situations are exploratory rather than completed and collective rather than individual, and are focused on the decision-making process [11]. In recent years, charrettes have been gradually introduced into various areas, including engineering, industrial design, architectural design, community development and urban planning [18]. Based on an experience of sustainable community development in rural Mexico, Valencia-Sandoval *et al.* demonstrated that a charrette is a cost-effective approach in several aspects, including proposing local policies, land use planning and building local capacity for landscape analyses [20]. Howard *et al.* compared two varying charrette processes experiences in the Auraria Library in Denver, Colorado, which were demonstrated to promote increased engagement with and investment in the planning process and outcomes. The study also highlights the value of authentic design participation of "designing with" rather than "design for" to encourage optimal design outcomes [21]. Additionally, most cases of charrette concentrate on the industries and education field [18], very few examples can be found in the post-disaster reconstruction context. One notable exception might be Tanaka's study, which is constructed in the post-disaster Kobe, Japan. This study suggests that a GIS-assisted multidisciplinary, intercultural, university-community collaborative charrette could help a community recover from an earthquake disaster [11].

3. Methods

The Minamisoma charrette lasted for 10 days, from 7–17 September 2014. The event was sponsored by a local NGO—the Association of Eco Energy of Minamisoma (AEM). Fourteen experts in land-use, landscape design, community resilience, farming, geographic information science and environment management participated in the entire charrette process. The experts were from Keio University in Japan, Swinburne University of Technology in Australia, and VHL University of Applied Sciences in the

Netherlands. All of the land-use and landscape-design experts were from non-Japanese-speaking countries. Local residents were recruited by the local NGO and participated voluntarily.

The main participants are listed in the Table 1 below. All participants listed in the Table 1 joined at least one session of the event.

Table 1. The description of participants.

Participant code	Specialization
Group 1 Local Residents	
R 1-R4	Community Leader
R 5-R23	Full time or part time Farmer
R 24-R38	Agriculture school student
R 39-R51	Non-agricultural Residents
Group 2 Academic Researchers	
A1-A2	Community Resilience
A3-A4	Farming
A5	Geographic Information Science
A6	Solar System
A7-A8	Land Use
A9-A11	Landscape Design
A12-A14	Environment Management
Group 3 NGO Officials	
N1-N3	Eco Energy
Group 4 Local Government Officials	
G1	Post–disaster Reconstruction
Group 5 Local Councillor	
C1	Farming

As a member of the expert group, the author participated in the entire design charrette process and sought to answer the following questions:

(1) What is the role of a design charrette in the post-disaster Fukushima?
(2) Can stakeholders sufficiently participate in the charrette?
(3) What are the contributions and constraints of design charrettes in post-disaster reconstruction? How can these constraints be ameliorated?

In this study, the data collection method consisted of primarily participatory observation. The author directly observed the entire charrette process from the perspective of a participant. The details of the process and the behaviors of the participants were recorded. After the charrette was finished, 28 participants were randomly selected for a non-structured interview. The primary goal of the interview was to obtain evaluations of the charrette by the participants.

4. Overview of the Study Area

A 9.0-magnitude earthquake hit the east coast of Japan in March 2011. The quake—one of the most devastating in human history—triggered a tsunami, which then caused the hydrogen explosion in the

Fukushima Daiichi Nuclear Power Plant (FDNPP). A large quantity of radionuclides leaked from the plant and polluted the natural and artificial environment, not only seriously affecting the lives of residents nearby, but also posing a hazard to the rest of Japan, even the whole world. The accident was thus rated Level 7 on the International Nuclear Event Scale, the most severe one since the Chernobyl accident [22]. Three years later, the reconstruction work in Fukushima was rather sluggish [6,23]. The decontamination of the six towns around the FDNPP had been expected to be completed by early 2014, but the environment minister recently announced that it would be delayed by up to three years [24,25].

Minamisoma City faces the Pacific Ocean in the east and has a total area of 398.50 km^2, 55% of which is covered by mountains and forests (Figure 1). As a coastal town near the FDNPP, Minamisoma is one of the worst hit regions in Fukushima. A totla of 636 people died directly from the disaster and nearly 3000 houses were demolished. In February 2011, the registered population in Minomisoma was 71,561 [26]. After the nuclear explosion, a great mass of residents was evacuated. The number of evacuees from Minamisoma accounted for 42% of all the evacuees in Fukushima, the highest in the whole Fukushima prefecture [27]. According to the census of March 2014, the number of pre-registered residents who still live in Minamisoma has reduced to around 48,800 [23]. The aging problem and the labor shortage are exacerbated. After the Fukushima accident, radionuclides of different concentrations were first detected in the air, soil and rivers, and later in cereals, vegetable and seafood produced in Minamisoma. The Fukushima disaster has also devastated the pre-existing industries in Minamisoma. Agriculture products, which used to have a good reputation, find no market. Manufacturing and other sectors are barely running below the full capacity due to the acute shortage of labor force.

After the disaster, both the central government of Japan and local government of Minamisoma set up a series of guidelines for reconstruction. In June and July of 2011, the central government of Japan successively enacted *the Basic Act on Reconstruction* and *the Basic Policy on Reconstruction*, budgeting nineteen trillion and twenty-three trillion yen, respectively, for the reconstruction in disaster-struck areas in Eastern Japan over a five-year term and ten-year term [6]. Later, the Minamisoma government issued *the Minamisoma City Revitalization Plan* in November 2011 and founded two administration departments leading the reconstruction, which are the Minamisoma City Revitalization Citizen's Committee and the Minamisoma City Revitalization Expert Committee [28]. The former organization is made up of city officials, community organization representatives and citizens, while the latter is comprised of academic experts from various fields. The reconstruction plan for Minamisoma covers a decade from 2011 to 2020, and the ten years can be divided into three stages: recovery stage, restoration stage and revitalization stage. The plan has three main goals: (1) to restore the population to the pre-disaster level, and enhance community cohesion; (2) to revive leading industries and revitalize economy; (3) to clean up nuclear contamination and rebuild a disaster prevention community.

Despite the full-scale support from governments and a huge quantity of resources allocated to the disaster area, the reconstruction progress in Minamisoma is still slow. The population's return, decontamination process and economic recovery have not shown big progress in the recovery [23]. In addition to the complicated situation in the disaster-struck area, many experts have also pointed out that inadequate participation of stakeholders in decision-making is another factor hindering the reconstruction process [6,16,17]. For example, when attempting to clean up the contaminated land in Minamisoma, the decontamination group met with strong resistance from landowners [29]. As most of the contaminated land is privately owned, it is extremely difficult to persuade all the landowners to approve of

the decontamination work. They refuse to accept the nuclear waste dump designated by the government and doubt the effectiveness of decontamination methods. The conventional top-down policy-making approach fails to win the understanding and trust of local residents and thus hinders the reconstruction process. In order to make residents more cooperative and trustful for reconstruction projects, resident participation in the decision-making process for reconstruction planning needs to be intensified.

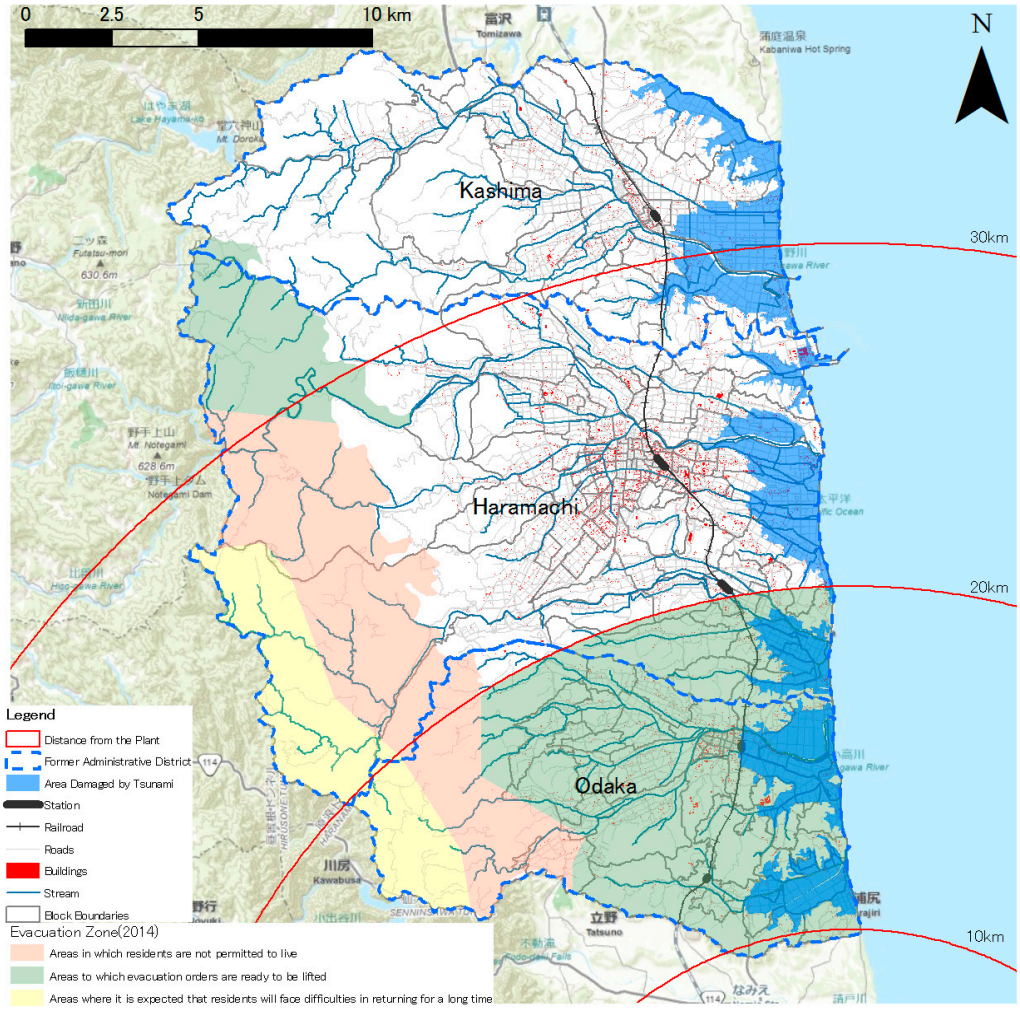

Figure 1. The map of the study area: Minamisoma City [23].

5. The Charrette Process

The charrette process included three stages: preliminary preparation, design and planning, and presentation and discussion. The primary objective of the preliminary preparation was to identify problems and unmet recovery needs from the residents by gathering materials and information that were relevant to the reconstruction process. This stage provided the foundation for the next stage. In the design and planning stage, the material collected from the previous stage was analyzed, and design ideas were generated. The participants then organized the ideas and produced a preliminary plan. The presentation and discussion stage involved presenting a plan and obtaining suggestions for improvements through discussion.

5.1. Preliminary Preparations

The preliminary preparations lasted for four days and involved a site visit, interview, disaster explanation session and focus group session. The site visits were selected by AEM and included major communities that had been affected by the tsunami and nuclear explosion, large agricultural farms, enterprises that processed agricultural products, the historical culture sites, and the implementation site of the solar energy project. During the visits, the participants performed unstructured interviews with 10 randomly selected residents. The main purpose of the interviews was to understand the unmet recovery needs of the local residents. The interviewees included a community leader, an NGO leader, an owner of a stud farm and farmers who had already implemented the solar power project. AEM also held a disaster explanation session for the participants. Community leaders and NGO members provided a detailed introduction on the course of the disaster and the current status of reconstruction efforts.

For the participants to acquire more extensive and in-depth planning ideas, AEM recruited local residents to organize a focus group and information-sharing session. There was a total of 68 participants in Groups 1–3. AEM assigned the experts and residents proportionally to six groups. The participants brainstormed on three subjects, including "Minamisoma pre-disaster status review", "Analysis of the current situation and post-disaster problems", and "Minamisoma reconstruction plans in the next 20 years". Each participant was asked to write down his or her ideas on a sticker and to place the sticker on a poster with a map of Minamisoma (Figure 2). The poster in Figure 2 demonstrates the results of the brainstorming section. It enabled all the participants to share the information and improved the identification and discussion of the existing problem. After the brainstorming, all of the generated keywords were combined and organized. One member of each group was then designated to present the group's ideas.

Figure 2. One of the maps of the brainstorming session.

5.2. Design and Planning

Twenty-four individuals participated in this stage, including R1-R5, R39-R40, A1-14 and N1-N3. The materials from the previous stage were analyzed. The goal was to identify problems that needed to be

solved and to clarify design ideas. This process provided foundations for the design and planning in the next step. The video and transcripts were translated from Japanese for the English-speaking experts.

The residents' major concerns about the reconstruction of Minamisoma can be generalized into the following three points: (1) The preservation and revival of traditional culture. The "horse-chasing ritual" is a famous non-material cultural heritage in Minamisoma. It is the common aspiration of the residents in Minamisoma to revitalize this cultural heritage so as to alleviate the acute labor shortage and give more vitality to gloomy economy; (2) The revitalization of the leading industry. After the disaster, the agricultural industry was devastated, as it was prohibited to sell agriculture products to regions outside Fukushima. Local farmers expressed their eagerness to see the revitalization and sustainable development of the local agriculture industry; (3) Sustainable supply of power. As the FDNPP is completely abandoned, residents hope to find a sustainable supply of power through other forms of renewable green energy.

In the design process, participants were divided into two groups. One group was responsible for planning the "horse-chasing ritual" tourism project. The other group was responsible for designing agriculture recovery plans and self-sustainable energy plans. Each group included six experts and six residents. The overall planning scheme was designed by the members in each group, and the key areas that were covered by the plans were labeled on a map with GIS technology. GIS technology was used to draw the map of the study area. The map provided the information of geographical features, the current statues of land use and the evacuation zone established by government. The participants then covered a poster-sized map with a transparent sheet, and the design plans were drawn by hand on the sheet. As shown in Figure 3, the participants presented a four-phase recovery plan for nuclear-contaminated farmlands. The figure shows a paddy of contaminated farmland that has been divided into four parts according to the difficulty of decontamination that will be restored by four stages.. After both groups completed their design plans (Figure 4), the plans were combined and further modified to generate a preliminary scheme that was made into presentation slides.

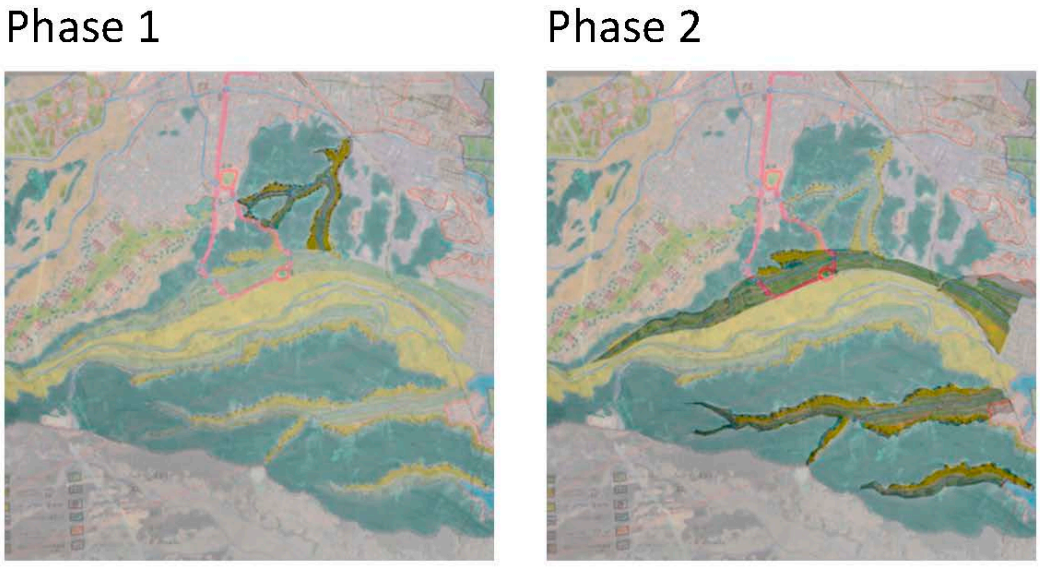

Figure 3. *Cont.*

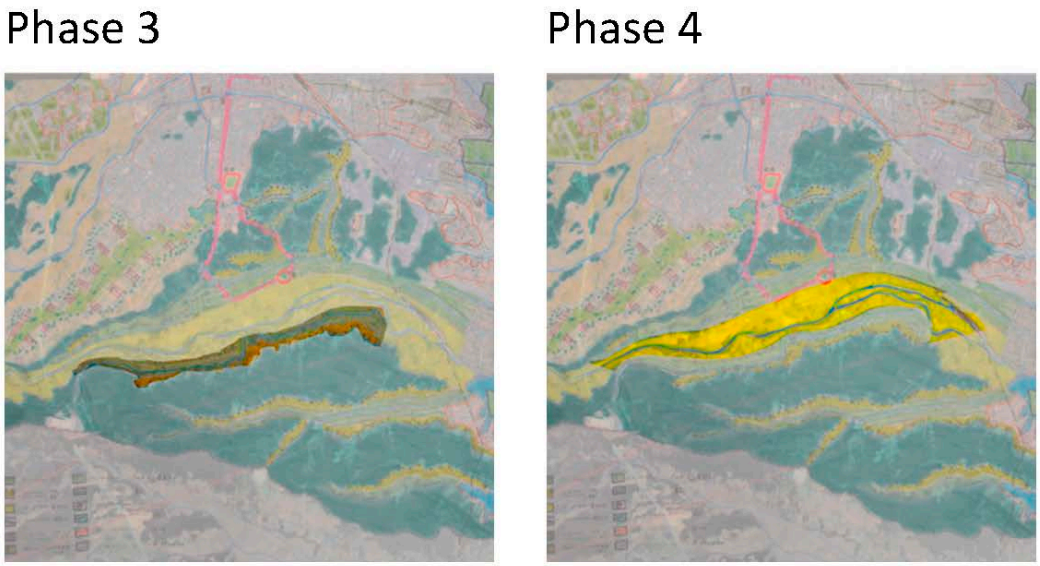

Figure 3. A four-stage pollution removal and farming recovery plan for nuclear-polluted farmlands.

Figure 4. A planning map from one team in the designing and planning section.

5.3. Presentations and Discussion

All individuals in Table 1 participated in the presentation and discussion stage. This stage included three sessions: presentation, question-and-answer (Q&A) and discussion. During the presentation session, the experts introduced and described the preliminary plan from the previous stage. During the Q&A session, the designers presented the design sketch and answered questions from participants. In the third session, participants were arranged into seven discussion groups to provide suggestions for improvements. The participants were asked to use clay modeling to exhibit the post-disaster reconstruction scenes on a poster-sized map (Figure 5). The clay modeling is a kind of design game

technique for visualizing alternatives. This technique could encourage more in-depth discussions and help the non-professional participants generate their ideas.

Figure 5. The clay modeling session.

6. Results and Discussion

In this section, the contributions and constraints of the charrette are described from a participant's perspective. In addition, practical recommendations regarding design charrettes are proposed for post-disaster reconstruction researchers and practitioners.

6.1. Contributions

The design charrette was a new model for post-disaster recovery assistance in Minamisoma. The charrette's contributions included the following aspects:

(1) Establishing an integrated perspective of the decision-making progress. The charrette helped the residents consider post-disaster reconstruction in its totality. With this approach, the local residents could avoid making decisions based on their separate, individual conditions. In the past, the understanding of a disaster-struck area by residents was sporadic and fragmented. Therefore, the residents would only consider reconstruction from their isolated perspectives and act according to their own will. In such circumstances, it is difficult to generate a unified planning blueprint, which is disadvantageous in the complicated situation of post-disaster reconstruction. The charrette process described in this study led to an integrated plan for the targeted area. In addition, it considered sustainable development over the subsequent 30 years, which expanded the view of the residents in time and space and helped them consider the entire situation. The establishment of this global view enabled the residents to obtain a clearer recognition of the location and effect of their own properties

(such as land) in the entire recovery blueprint. The integrated perspective united the focus on individual recoveries with the focus on the recovery of the entire area. Participant R1 noted,

> *"The Minamisoma government had proposed a post-disaster recovery blueprint in 2011, but the plan was not actually executed because the government came across many difficulties when trying to persuade the land owners to support the decisions in the plan. Every resident had his or her own opinion on the reconstruction, and no common ground had been reached. This was an important reason for the slow recovery of this area. However, the charrette enabled the participants to discuss the reconstruction plan from an integrated point of view and thereby tremendously helped to establish common ground."*

(2) Promoting communication and collaboration. The involvement of stakeholders in the entire decision-making process promoted communication and collaboration between various parties. After the Fukushima accident, the local residents distrusted the central and local governments and government-support research institutions. Traditionally, Japanese post-disaster planning had primarily been determined by government officials and professionals. This traditional approach excluded the residents from the planning process, which easily resulted in the resistance of these residents. Particularly when a universal loss of trust in the government occurred among the residents, the plan generated by the traditional approach was barely acknowledged by the residents and hard to execute. The charrette facilitated the participation of local residents in the detailed plan-generation process and helped them understand the reasons, procedures and objectives of all of the detailed plans. The proposals from the various participating parties could receive immediate feedback, and the communication between the various parties could be enhanced by collaboration. This process made it easier for the residents to reach agreement on the final recommendations. Participant R6 stated,

> *"I participated in the entire process of this activity, and it was beneficial. In the past, novel suggestions were very hard to accept, such as the installation of solar panels in the farmland for power generation. Now, I can reconsider these issues. The experts described a prosperous future after the reconstruction, and it will be great if achieved."*

(3) Inspiring new reconstruction ideas. Participants presented new reconstruction alternatives to the decision makers. After the Fukushima accident, the phrase "cannot find a way out" came to represent the largest struggle among the residents in Minamisoma. Participant R40 observed,

> *"Many people were suffering after the disaster, and they wanted to return to the situation before the disaster. It was impossible because the environment was completely changed. We can only adapt to the current conditions and search for new directions for development. However, no one knows how to achieve such a development."*

The design charrette adopted the brainstorming method and combined the wisdom of various age groups, different professionals and individuals with various educational backgrounds. This approach provided an entirely new perspective and mindset. This process opened up the vision of the decision makers and the residents and offered them the possibility of a homegrown reconstruction. Participant R24 stated,

> *"We considered growing Brassica in the polluted land. The refined canola from Brassica would not contain nuclear pollutants. In this case, it is not necessary to decontaminate the land. In this discussion, someone proposed making the Brassica field a landscape attraction area and part of the 'Horse-chasing Ritual' tourism project. This idea is wonderful!"*

(4) Regenerating "post-disaster utopia". The design charrette regenerated a vision of a "post-disaster utopia" by encouraging residents to demonstrate confidence and courage in post-disaster reconstruction. The phrase "post-disaster utopia" refers to a phenomenon that occurs after a recent disaster when local residents are in the process of helping one another and a large group of outsiders arrives to help the residents overcome difficulties [30,31]. However, this phenomenon does not last long. In Minamisoma, because of the long-term nuclear radiation pollution and the loss of large segments of the work force, many residents lost confidence in the future development of the region. The design charrette provided another opportunity for outsiders to come and support the disaster-struck area, which enabled the residents to feel that they were receiving assistance again and restored confidence and courage in the reconstruction. Participant N1 noted,

> *"In the first year after the disaster happened, a large group of volunteers arrived here from all over the world to help in disaster restoration. There were many people who concentrated here and extensive reports regarding the disaster area were broadcast on the TV news. However, right now, the situation here has not improved at all, but the world seems to forget about us. The charrette brought many outside experts back here. We feel very much encouraged, and we hope they can send our information out to the world."*

6.2. Constraints

As a participatory reconstruction method, the design charrette in Minamisoma displayed several constraints.

First, not all of the key stakeholders were recruited to participate in the charrette. The triple disaster created a complicated situation in Minamisoma. To design a reconstruction plan in an environment that was this complex required sufficient communication with every key stakeholder to acquire his or her support and approval. This charrette was organized by AEM in the form of voluntary participation. Although the charrette received support from local community leaders, the participation of every landowner was not assured. One of the most important reasons may be the weak leadership of the NGO in the community, having been unable to adequately recruit all the key stakeholders. In this case, although the stakeholders who participated in the event agreed on the final result, there was no guarantee that the non-participating stakeholders also agreed.

Secondly, important professionals (such as land use planners) of the charrette all came from non-Japanese-speaking countries, and local professionals in related areas did not participate. Before the charrette, fieldwork and interviews were performed to help the outside professionals recognize local issues. However, for foreigners with language and cultural differences, it was difficult to obtain all of the key information in a short period of time. Important professional information was partially missing. To design the plan, the experts could only use previously acquired knowledge and experience

and cursorily collected local information. This approach caused errors in the details of the resulting plan. For example, the experts failed to consider restrictions on land use (e.g., farmland cannot be used for non-agricultural purposes) stipulated under current Japanese law. Although such problems may be resolved in the future, they decreased the practicality of the final outcome and increased the time spent in plan execution.

Thirdly, the non-professional local participants lacked training. A post-disaster reconstruction plan should be based on an understanding of the environmental and social factors of the disaster-stuck area and their interrelations by all of the stakeholders who participate in the decision-making process. Such planning also requires participants to master certain skills and knowledge needed to analyze and make decisions. However, it was difficult for the non-professional participants to possess all of these qualities. The complicated and unpredictable circumstances of the disaster area created an even greater obstacle to the participants who lacked professional training. Thus, decisions were probably made based on instinct rather than critical thinking, which affected the efficacy of the result. Additionally, the designer aimed to promote the participation of non-professional local residents in this charrette and included a session of landscape modeling using clay. This exercise was used to enhance the operational sense of the non-professional local residents and thus to enable them to contribute ideas to the planning scheme. However, this session seemed to generate a limited effect. Regarding the modeling, participant R20 noted,

> *"This process was very interesting, and we concentrated on it greatly. However, it did not seem to affect the final result. It seems that many people just treated it as a game."*

Participant N3 offered the following suggestion:

> *"Many people have made very creative architecture and landscapes, but these creations were too unrealistic, and I think they are hard to realize. Unfortunately, we need a plan that can be executed as soon as possible and can improve the current situation."*

6.3. Possible Improvements

The preceding analysis affords the following suggestions for future researchers and practitioners in the use of design charrettes in post-disaster reconstruction. These proposed measures are mainly to improve the legitimacy and policy compliance of the charrette's final result. First, the adequate participation of the key stakeholders is a necessary condition for the power and legitimacy of the final result. Key stakeholders are those individuals who directly or otherwise importantly influence decisions [32]. Key stakeholders include policymakers, landowners, notably reconstruction planners and local authorities, construction contractors/builders and scientific or research institutions in the post-disaster context [33]. In a post-disaster reconstruction scenario, to assure the participation of all of the key stakeholders in the targeted area, the charrette's organizer could increase advertisement and communication efforts by ensuring sufficient cooperation with government and community leaders. Furthermore, the organizer could offer a financial compensation in proportion to the participants' contribution, which may attract more stakeholders to be involved. To avoid the participation of some people merely for the sake of money, the participants should be under supervision to ensure that

nobody can contaminate and bias the process. In addition, decreasing the scope of the targeted area could reduce the recruiting pressure. Moreover, during the preparation stage of the charrette, communication between experts and local residents as well as the training of these residents should be enhanced. The problem of the insufficient understanding of the local culture and the policy background can be addressed by improving the pre-charrette communication between the foreign and local experts. Additionally, it is necessary to train all of the participants and to explain each section of the charrette process in detail. In particular, an effective introduction and guidance should be provided to the non-professional participants to ensure their effective participation during the entire process. Finally, it is important to introduce resource analysis during the charrette's preparatory stage. Insufficient resources and their uneven distribution are common problems in post-disaster areas [33]. An effective analysis of the available resources of the post-disaster area is an important condition to ensure the feasibility of the charrette's final outcome. Available resources can be confirmed by a field survey during the early stage of the charrette by analyzing available labor, materials and historical and cultural resources. After this, the most important development areas can be determined. In addition, the scale and cost of the execution of these projects can be evaluated, which can potentially strengthen the feasibility of the charrette's final outcome.

7. Conclusions

In this study, a participatory observation was performed on a design charrette held in post-disaster Minamisoma, Fukushima, Japan. The execution and effects of this approach were investigated. The charrette was based on GIS technology and was run with the participation of multiple stakeholders in an intercultural, intergenerational and interdisciplinary collaboration. According to the observation of the entire charrette, the authors noted the following contributions of the design charrette as a participatory reconstruction method: (1) The charrette helped the residents consider post-disaster reconstruction in its totality; (2) The involvement of stakeholders in the entire decision-making process promoted communication and collaboration between the various parties; (3) Residents contributed reconstruction alternatives to the decision makers; (4) The design charrette recreated a "post-disaster utopia". However, because of limitations of resources and environment, the charrette described in this study displayed certain constraints during the execution process. The limitations were primarily as follows: (1) The voluntary organizational structure could not guarantee the participation of all of the key stakeholders; (2) Due to cultural differences, the foreign experts could not sufficiently master the cultural and policy backgrounds of the disaster-struck area, which decreased the practicality of the final plan; (3) The efficacy of the participation of non-professional residents was limited by their educational and professional backgrounds.

Accordingly, the following suggestions for future post-disaster reconstruction charrettes are proposed: (1) The organizers should sufficiently collaborate with local government and community leaders to ensure the participation of all of the key stakeholders in the targeted area. The scope of the targeted area can be decreased to reduce the pressure of recruiting and to assure the legitimacy of the final outcome; (2) The communication between the foreign and local experts and the training of nonprofessional residents should be enhanced during the charrette's preliminary stage; (3) The

inclusion in the charrette of an analysis of resource availability in the disaster-struck area could increase the feasibility of the final output.

Participatory reconstruction has been widely recognized as an effective approach to post-disaster reconstruction. However, the literature provides scant information regarding the detailed method of such participatory reconstruction. This case study enhances the comprehension and recognition of the design charrette method. In addition, it provides reference experiences for future researchers and practitioners who would organize similar activities in a post-disaster area. As a severe disaster with global impacts, the environmental and social effects of the Fukushima event have attracted substantial academic attention. However, the current literature in English on Fukushima's post-disaster recovery and reconstruction is scant. This study could contribute to the understanding of specific problems of the Fukushima post-disaster reconstruction. One limitation of this study is that no follow-up studies on the adoption and execution of the final plan have been conducted. Therefore, the long-term performance and efficacy of the charrette's output with respect to post-disaster reconstruction could not be determined. In future studies, the question of how to improve the design charrette's organizational structure to better adapt to post-disaster conditions can be investigated. In addition, to determine the long-term contribution of the design charrette, effective evaluation methods such as the ALNAP evaluation method [34] could be applied.

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Author Contributions

Hui Zhang carried out the study design, all analysis, and manuscript preparation. Zijun Mao participated in the study design, and provided suggestions and feedback on the interpretation of the data. Wei Zhang participated in revising the manuscript critically for important intellectual content. All authors have read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest in any aspect of the data collection, analysis, or the preparation of this paper.

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