

Spatial and Project Planning Characteristics of Post-disaster Settlement:

A Case Study of Reconstruction After Typhoon Morakot in Taiwan

災害復興移転集落の空間配置と計画の特徴 - 台湾モラコット台風の再建事例として

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2009 年 8 月台風モラコットは台湾に前代未聞の災害をもたらした。その後、政府は大規模な復興計画を実施した。台風モラコットの災害復興に関する研究を俯瞰的に理解するため、本研究では、全国 35 ヶ所の復興集落空間とその計画の特徴に注目し、また復興支援を担った地方自治体および NGO の意思決定の違いを分析した。本研究の結論は、1) 高雄地域が移転世帯数が多く、被災コミュニティが統合し移転した事例は多い。2) 35 集落は、6 種類の集落配置タイプに分類でき、様々な状況に応じ異なった配置タイプを用いたが、そのうち複合型の計画手法が住民から評価された。3) 復興効率を優先する地方自治体や NGO がいる一方、被害者間のコミュニケーションや住民参加を優先する地方自治体や NGO もあるなど復興支援を担うステークホルダー間で大きな違いが見られた。4) 国有地が再建用地になるケースは全体の 8 割にのぼった、しかし、元居住地と移転集落の関係を維持することが難しくなった。

Keyword: Settlement planning, Typhoon Morakot, Post-disaster reconstruction, Government policy, NGOs
復興計画, 台風モラコット, 災害復興, 政府政策, NGOs

1. Research background

Natural disasters have increased in Asia, especially in Taiwan. According to Daly (2016), more than 80 percent of the natural disasters in Taiwan are typhoons¹⁾. The most well-known disaster caused by a typhoon in Taiwan is Typhoon Morakot, which hit between August 6th to 10th, 2009. It claimed 643 lives and destroyed 1,626 houses, rendering them uninhabitable²⁾. The economic loss was estimated to be around 199.83 billion TWD (4.28 billion USD)³⁾.

After Typhoon Morakot, 160 areas were designated as disaster-affected within five months. A total of 6,316 households were affected and moved to the evacuation center. Regarding the reconstruction project, the central government decided to skip the temporary house provision and directly constructed permanent houses⁴⁾. Construction was outsourced to large-scale NGOs with the local government's support, to save money and time, as these NGOs received huge public donations after the typhoon. The main executive NGOs were the Buddhist Compassion Relief Tzu Chi Foundation (hereinafter Tzu Chi), World Vision Taiwan (hereinafter World Vision), the Red Cross Society of the Republic of China (hereinafter Red Cross), and four others. Tzu Chi was founded in 1966 by a Taiwanese Buddhist group. With more than 80,000 volunteers, Tzu Chi mainly focuses on humanitarian activities such as education, humanities, and post-disaster reconstruction (PDR). Before Typhoon Morakot, it had participated in numerous PDR programs both internationally and domestically, such as the 2004 Indian Ocean Earthquake and 1999 Ji-ji Earthquake⁵⁾. Founded in 1951 by an American missionary, World Vision focuses on poverty alleviation, child education, and limited PDR programs. The Taiwan branch was founded in 1964. These were dedicated to the PDR program before Typhoon Morakot⁶⁾. Founded in 1863 in Swiss, Red Cross had expanded to Taiwan since 1904. As an international NGO, the organization is present in the aftermath of several large-scale disasters⁷⁾. Due to the early missionary activities from the 1950s, World Vision and Red Cross had established their popularity and connections in Taiwanese mountainous communities, which comprise most of the disaster victims of Typhoon Morakot.

Despite the array of research, the focus of the PDR program after Typhoon Morakot was on the participatory design process, NGO-government partnership, and spatial changes. However, most of the related research limited the scope of the large-scale reconstructed settlements. The previous literature also lacks a comprehensive perspective to analyze the 35 reconstructed settlements, from the viewpoints of spatial and project characteristics and the local communities. Nonetheless, this unbalanced focus might hamper the evaluation and understanding of the PDR program after Typhoon Morakot.

2. Literature review

Regarding the increase in natural disasters, the international society had worked towards curbing the destructive effects on the lives and livelihoods of individuals and communities. The 1990s is known as the “decade for reducing disaster risks.” The PDR's status was again ratified in the Sendai Framework for Disaster Risk Reduction 2015-2030⁸⁾. It is paramount in the disaster management field.

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Multidimensional tasks in PDR entail multiplying complexities for organizing the reconstruction process, from high-level policies to operational arrangements. It is better to analyze it through spatial and planning aspects, and a community-based viewpoint.

(1) Spatial aspects

It is reasonable to understand the post-disaster reconstruction is implemented in the aftermath of a disaster. Haigh and Amaratunga (2011) stated that the PDR plays a vital role in rearranging the built environment. Its resilience will show when we design, develop, and manage buildings, spaces, and places⁹⁾. First, it is important to decide who should be relocated and where. Regarding this issue, Ishikawa et al. (2008) used the PDR after Mid Niigata Earthquake to analyze the number of households to be relocated and the location for it¹⁰⁾. Using Ishimaru et al. (2015), the pattern of relocation was categorized, considering the segregation or integration of pre-and post-disaster communities¹¹⁾. The relocation pattern and allocation of permanent housing and settlement can affect the communities' post-disaster recovery. Thus, the geographical distribution analysis of households and settlements was conducted to understand how they were relocated after Typhoon Morakot (First analysis item). Second, another vital issue is determining the reconstructed settlement's design and configuration. Using the East Japan Great Earthquake in 2011, Ishimaru et al. (2015) classified the configuration of the reconstructed settlements in the Tohoku area into four types¹¹⁾. Charlesworth and Ahmed (2015) collected the case studies from Australia, Bangladesh, Haiti, and Sri Lanka and analyzed the relationship of the permanent housing in the reconstructed settlements¹²⁾. Two studies found that the configuration was closely related to the environmental conditions and involvement of communities' participation. Therefore, the settlement configuration is also an analysis item in this research (Second analysis item).

(2) Planning aspects

A well-conducted PDR program entails good planning. As stated by Arefian (2018), the multi-stakeholder collaboration often determines the PDR programs' success⁸⁾. Among the various planning-related elements, two of the most decisive are time management and land ownership issues. In Japan, before the housing construction, the government spent substantial time consulting the future housing options of the disaster victims. However, according to Kondo and Karatani (2018), the research showed that if the reconstruction process took too long, the disaster-affected households might decide not to return to their original communities¹³⁾. After the Wenchuan Earthquake in 2008, the top-down Chinese government facilitated the long-term recovery of the local communities¹⁴⁾. Thus, in this research, the settlement construction period is a crucial analysis item (Third analysis item). It is difficult to ignore the obstacle of land ownership in the PDR program, as suggested by Brown and Crawford (2006). They observed the 1977 Divi Seema Cyclone in India and found that the wealthy landowners controlled the arable inland after the cyclone, which forced the poor inhabitants without land ownership to move from the interior to the coast and deepened their vulnerability¹⁵⁾. In Taiwan, there was a conflict between the government and local communities, because the former tried to evict residents from their land¹⁶⁾. Therefore, the land ownership issues in the PDR program after Typhoon Morakot need to be analyzed (Fourth analysis item).

(3) Community-based viewpoint

The NGOs and government have gradually become aware of the importance of local community participation in the PDR programs⁸⁾. Recently, the community-centered approach was adopted in PDR-related research. For instance, the research on satisfaction with PDR after the Indian Ocean Tsunami in 2004 was conducted in Sri Lanka. It showed that the spatial and planning issues influence communities' long-term satisfaction¹⁷⁾. The result had been endorsed by the satisfaction survey done after the 2010 flood in Pakistan¹⁸⁾. Hence, the viewpoint from the community is indispensable during the analysis of the PDR program.

3. Analysis process and methodology

As mentioned above, considering the spatial and planning aspects, this research aimed to analyze i) household and settlement geographical distribution, ii) settlement configuration, iii) settlement construction period, and iv) land ownership issues. The implications and suggestions should be provided to facilitate the future PDR projects.

First, regarding the household and settlement geographical distribution, this research collected secondary information ranging from newspapers, websites, and government publications to understand the number of relocated households, newly built permanent housing, relocated communities, and permanent housing settlements in different counties. The regional difference is therefore compared and analyzed. Second, regarding the settlement configuration, based on the classification of Ishimaru et al. (2015), the reconstructed settlements after Typhoon Morakot were categorized into six types. A drone survey of the 35 settlements was conducted to compensate for the architecture offices and the

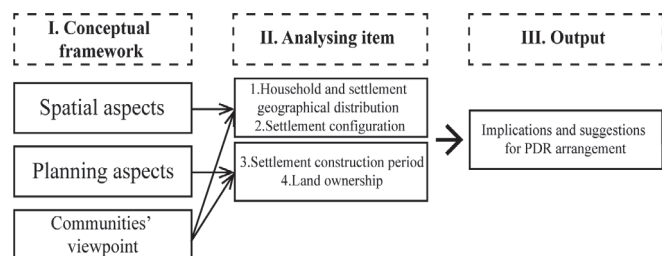


Figure-1 Research flow chart

government's settlement plan. The configuration was plotted onto the drawing software. Afterward, a cross-analysis with the NGOs and counties was implemented to compare the characteristic of different configurations. Third, to understand the difference of construction period, the cross-analysis of period-counties and period-NGOs were conducted to understand the factors which caused the difference in the construction period. Finally, as the county government was the main stakeholder in deciding the location of reconstructed settlements, the percentage of government-owned land and private land in different jurisdictions was shown.

Moreover, since this research also applied the communities' viewpoint, the authors conducted several semi-structured interviews with various settlements' reconstructed households. Five settlements were selected as the number of households in each was above 100. Moreover, local government personnel, architects, and NGOs were also interviewed. The interviewees are listed in Table 1. The evaluation and interview results from the communities regarding the four analysis items, are presented. Some implications and suggestions regarding the PDR arrangement are provided. The research flowchart is provided in Figure 1.

Table-1 Interviewees' information and the contents of the interviews

Interviewees' code	Note	Number	Interview abstract
G1	Pingtung County government	1	- Post-disaster reconstruction strategy
N1-N3	NGOs (Tzu Chi, Red Cross, and World Vision)	3	- Planning ideology
A1	Architects (Rinari settlement)	1	- Planning ideology
R1-R16	Rinari residents	16	- Evaluation of the post-disaster reconstruction policy
W1-W14	Ulalijuc residents	14	- Trajectory of the relocation
X1-X19	Xinlaiyi residents	19	- Evaluation of the settlement design and planning
C1-C16	Changzhi Baihe residents	16	- Life satisfaction
J1-J16	Jia Lan residents	16	

*Interview period: August 2017, February and August 2018, April and August 2019, and November 2020.

4. Research findings

(1) Household and settlement geographical distribution analysis

This analysis was conducted to understand the overall distribution of relocated households and construction of permanent housing settlements in different regions. The research found that Kaohsiung City and Pingtung County relocated and constructed more than 1,000 households and permanent housing settlements. These were the large-scale construction sites. There were between 100 to 1,000 relocated and constructed households in Chiayi County, Taitung County, and Nantou County, which were deemed medium-sized construction sites. Yunlin County and Tainan City were small-sized construction sites, with only a few relocated households and permanent housing settlements constructed (Table 2).

Regarding the number of permanent housing settlements, to save money and consumption of construction land, Kaohsiung City had only six permanent housing settlements, despite having the most relocated communities and numerous relocated households. A similar situation was observed in Pingtung and Chiayi (Table 2). The residents stated that in Pingtung, some relocated communities had been amalgamated into one permanent housing settlement. Nonetheless, because of different lifestyles and cultures, communities had some disputes and faced difficulty in reaching a consensus (Interviewees: C2, C3, C8). However, the residents stated that in Taitung County, the solidarity of communities had been respected and they were rebuilt independently. The arrangement was evaluated highly by the residents (Interviewees: J1, J4). Hence, it is essential to consider the solidarity of the community in the relocation strategy.

Table-2. Number of the relocated households and built households

	Kaohsiung	Pingtung	Chiayi	Taitung	Nantou	Yunlin	Tainan	Total
Relocated households	1,317	1,314	509	229	183	28	54	3,634
Newly built permanent housing	1,317	1,314	512	229	183	28	55	3,638
Size of the reconstruction project	Large	Large	Medium	Medium	Medium	Small	Small	N/A
Number of relocated communities	18	18	18	7	3	3	4	71
Number of permanent housing settlements	6	8	7	7	4	1	2	35

(2) Settlement configuration analysis

This research reviewed the actual configuration of Taiwan's permanent housing and proposed six types of configuration: i) single loop, ii) grid, iii) community central, iv) single-sided linear, v) double-sided linear, and vi) compound (Figure 2). The categories were based on the shape of the road and allocation of the housing. The single loop type referred to planning the community's main roads in a single ring shape, with more than 50% of the houses allocated inside the ring. The grid type was a multiple version of the single loop, with more than 50% of the houses in the ring. Multiple grids cut the settlement into different street blocks for different relocated communities. Community central type was shaped as the grid with an additional community plaza, which indicated that the design incorporated the facility or non-housing functions in the settlements. The single-sided linear type showed that all housings were allocated on the single side of the road. However, in the double-sided linear type, some housings were allocated on either side of the

road. Compound types referred to the settlement configuration used in two of the abovementioned arrangements. Figure 3 shows the configuration diagram for the 35 permanent housing settlements after Typhoon Morakot. The relationship between roads and permanent houses aligned with the settlement's name and the configuration type number. According to the classification result, five settlements belong to the single loop type, six to the grid, six to the single-sided linear, and the largest fraction of 11 settlements belong to the double-sided. Only three settlements adopted the community central type, and four the compound type.

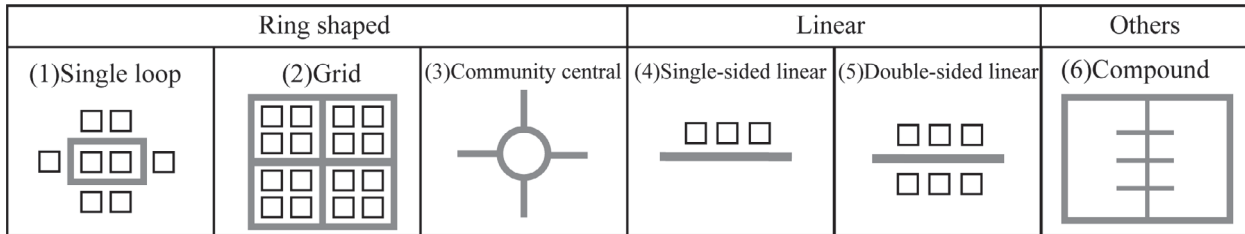
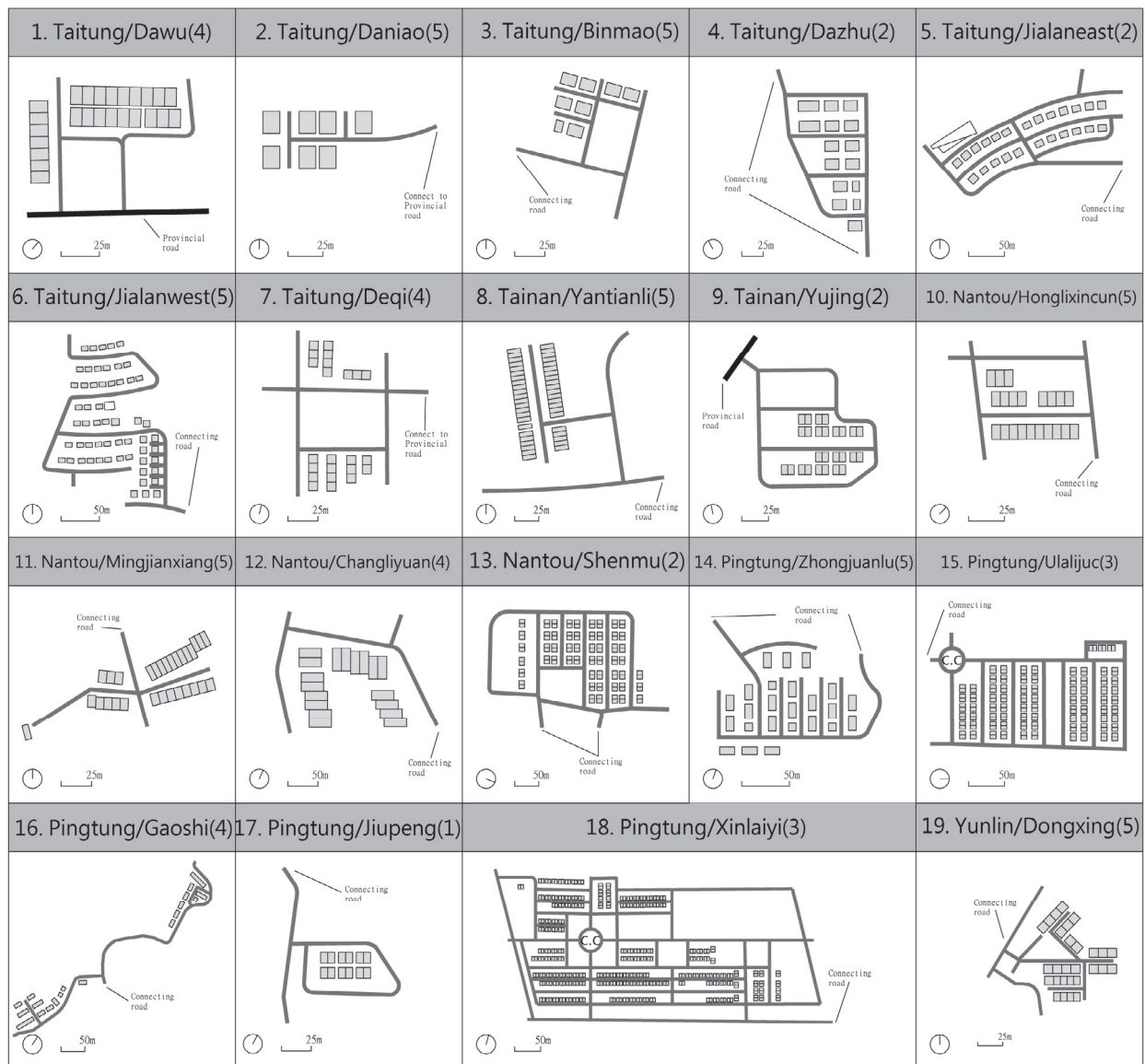


Figure-2. Six types of configuration patterns of the permanent housing settlement



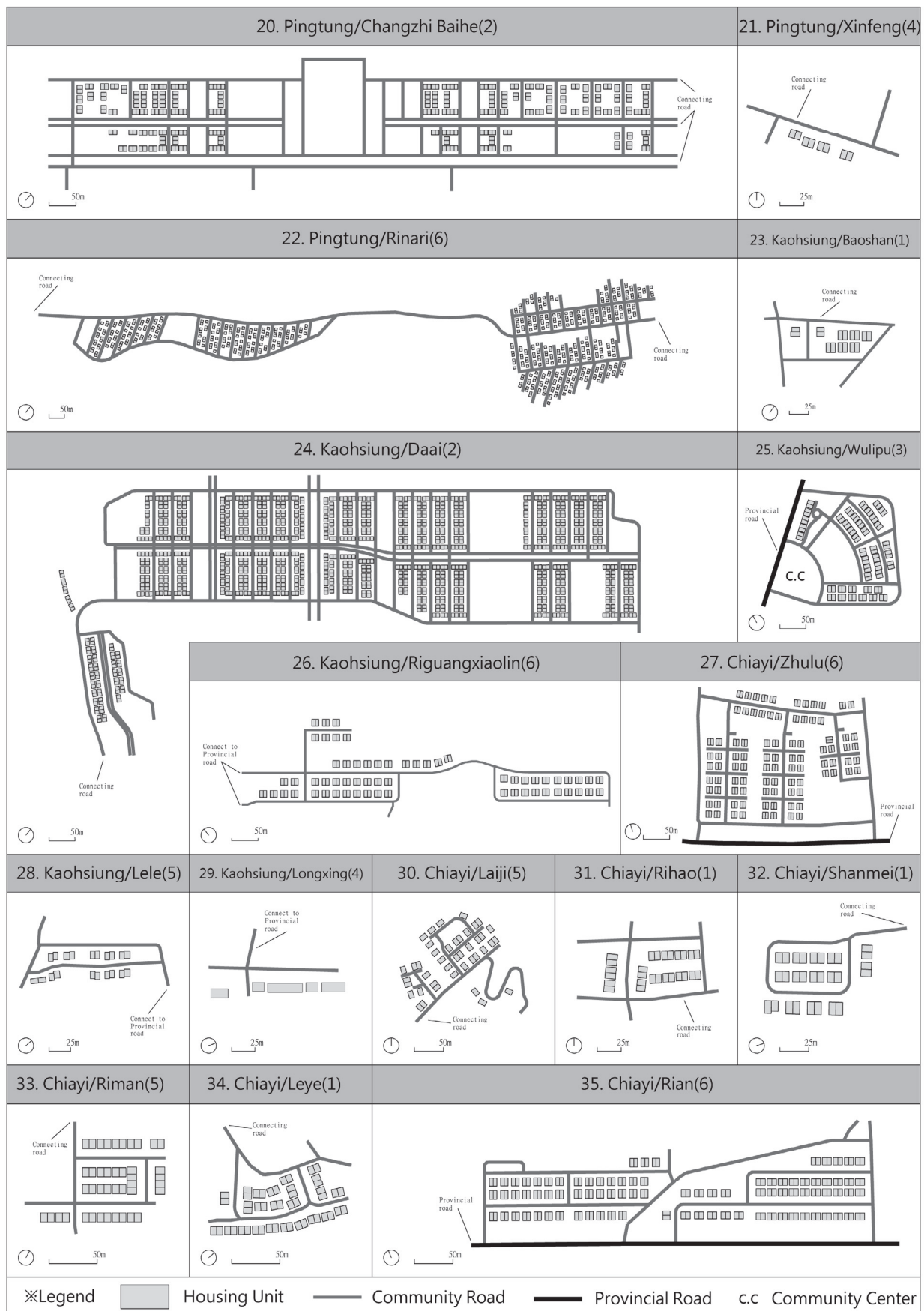


Figure-3 The configuration of the settlements and the configuration types

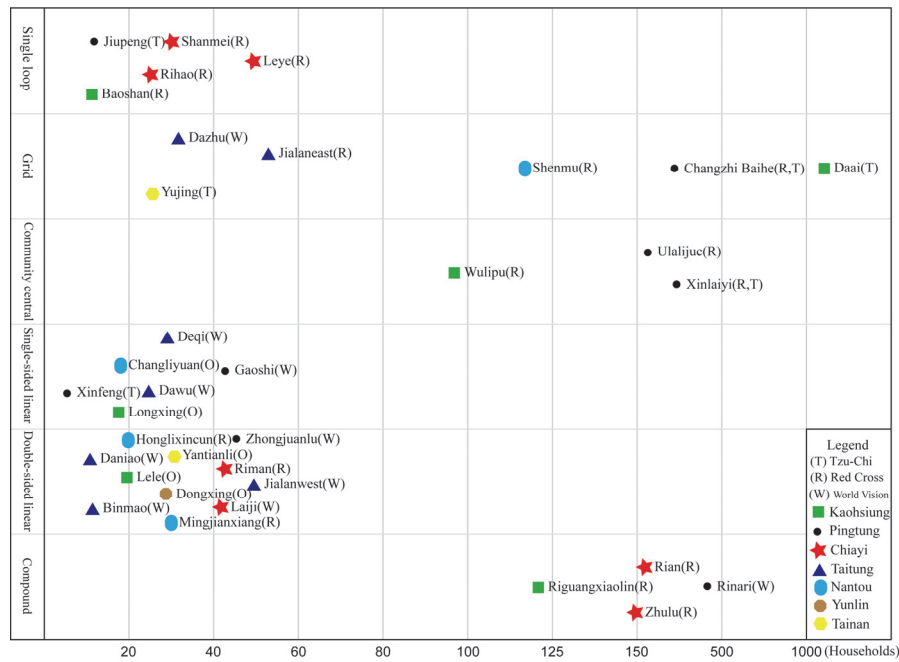


Figure-4 The relationship of permanent housing settlements' configuration types, located area, constructing NGO, and number of households

Next, this research analyzed the relationship between settlements' configuration types, located areas, constructing NGOs, and the number of households. The result was plotted in Figure 4. Regarding the located area, it was evident that the settlements in Kaohsiung City and Pingtung County were evenly distributed among each configuration type. Those located in Chiayi County were concentrated in the single loop, double-sided linear, and compound types whereas in Taitung County and Nantou County were concentrated on the grid, single loop, and double-sided linear types. Regarding housing number, due to the simple structure of the single loop, single-sided linear, and double-sided linear types, they were applied by some small-scale household settlement planning, while its extended version—the grid type—was used by some large-scale settlement planning. The community central and the compound types were also suitable for large-scale settlement planning.

Regarding the NGOs, the Red Cross planned for five different configuration types except for the single-sided linear type. The settlements built by it had high diversity and were evenly distributed in disaster-affected counties and cities. It meant that the Red Cross cooperated with multiple local governments for permanent housing construction. The design strategy could vary due to differences in cooperation from regional governments and local environment conditions (housing number, construction land size, and shape). Tzu Chi used the grid type for most of its projects. The constructed settlements' scale had high variance, with three large-scale and three small-scale. The reconstruction projects were in Kaohsiung City and Pingtung County. As for World Vision, except for its largest settlement—the Rinari settlement, with 483 households and located in Pingtung County—the rest of the projects were in Taitung County, where the communities had been receiving their support even before the typhoon. In Taitung, the households' size per settlement was below 100. The settlement size and the usage of the irregular-shaped construction sites also explain why mostly World Vision used single-sided linear and double-sided linear types, since the linear-shaped can best adjust to the topography and environment condition.

The interview results showed that residents were unsatisfied with the grid-type configuration due to the lack of privacy, the scarcity of the arable land, and the public facilities (Interviewees: C1, X8). Although the community central was similar to the grid type, for the resident, it was different. For example, the Kaohsiung Wulipu had a community square with a disaster-related museum and a traditional community center. Pingtung Ulalijue and Xinlaiyi had a loop road as the community center, where both the settlements erected a stone pillar and scripture to portray the community's history before the disaster. The residents stated that though the settlement applied the grid configuration, the community plaza's allocation allowed residents to have sufficient community facility or symbolic status, which helped restore their lifestyle and culture (Interviewees: X7, U6). The compound type had the most complex structure, as it applied more than two configuration types. Nonetheless, it had been highly evaluated by the residents. For example, the main road connected the settlement with the other regions and served as the buffer zone for the three relocated communities in the Rinari settlement, as they shared different cultural identities and lifestyles. Conversely, the community roads were planned between permanent housings, to boost the accessibility while maintaining suitable privacy for each household (Interviewees: A1, R3). The residents also stated that the World

Vision and architect had invited local communities to participate in the discussion at the initial stage of the planning. They had approved the allocation of housing and the configuration before the construction. The settlement configuration analysis shows that it might vary due to the number of housing in the settlement and the local geographical condition. Moreover, the planner and architects' consideration of community facilities and culture also played a critical role. The inclusive discussion with the local communities can often result in communities' high evaluation of the settlement design. In the case of large-scale settlement, the compound configuration seems to be superior to other planning strategies.

(3) Settlement construction period analysis

This research first analyzed the relationship among the location of the post-disaster settlement, construction period, and settlement size. The result was plotted in the upper part of Figure 5. The graph showed the sporadic numbers of the constructed housing and the few settlements in Nantou County, Yunlin County, and Tainan City. The entire construction work in these regions was finished within 400 days. Two special cases are Kaohsiung City and Pingtung County. Despite the considerable number of permanent housing settlements constructed and the divergence of each settlements' size, the local government surprisingly used an average of 252.86 days and 251 days, respectively, to finalize the project. The NGOs' perspective presented at the bottom of Figure 5 indicated that because of the cooperative relationship with the Kaohsiung City government, Tzu Chi rushed to finalize its construction project. Given the diversity of the reconstruction projects nationwide, there was no prominent characteristic of the Red Cross's construction time. Due to the Taitung County government's cooperation, World Vision spent more time on relatively small projects.

According to the interview, the Pingtung government and Tzu Chi representatives stated that they prioritized the construction due to pressure from the central government (Interviewees: G1, N1). However, the residents complained about the low housing quality and reckless implementation of post-disaster settlement planning, which did not match community needs (Interviewees: R10, C7, X6). In contrast, in Taitung County, regardless of its relatively small-sized settlement, the government and World Vision insisted on sufficient discussions with local indigenous communities without compromising local welfare (Interviewees: N2). Therefore, although more time was spent on the construction, the relocated households praised the well-implemented discussion agenda and the participatory framework which facilitated the post-disaster recovery process (Interviewees: J6, J10, J11). From the settlement construction period analysis, it is evident that the communities' opinion and welfare should be the priority during the PDR implementation. The residents might not value a speedy solution if their expectations are not met. Interestingly, different regional governments and NGOs might have distinct attitudes and concepts toward settlement planning and design.

(4) Land ownership analysis

Finally, this research focused on construction land ownership (Table 3). The Pingtung County government decided to use its government-owned land for the projects, given the relatively large size and completeness of the land to accommodate more permanent housing in a single settlement. Conversely, despite the significant number of projects and enormous government-owned lands, the Taitung County government decided to talk to local landlords to acquire their land for the reconstruction projects. This was because their government believed that relocating disaster-affected households close to their pre-disaster settlement, was crucial for the residents' disaster recovery process. Moreover, this private-owned land acquisition policy can maintain the linkage between the new and pre-disaster communities. According to the residents, because of relocation to government-owned land, most of the reconstructed settlements were too remote for the original settlements, making it difficult to maintain the connection with their relatives living in the original communities. Hence, some residents were not satisfied with the new environment (R1, C6). On the contrary, in the Jialan settlement, since the original community is a five-minute walk away from the newly reconstructed settlement, the linkage and

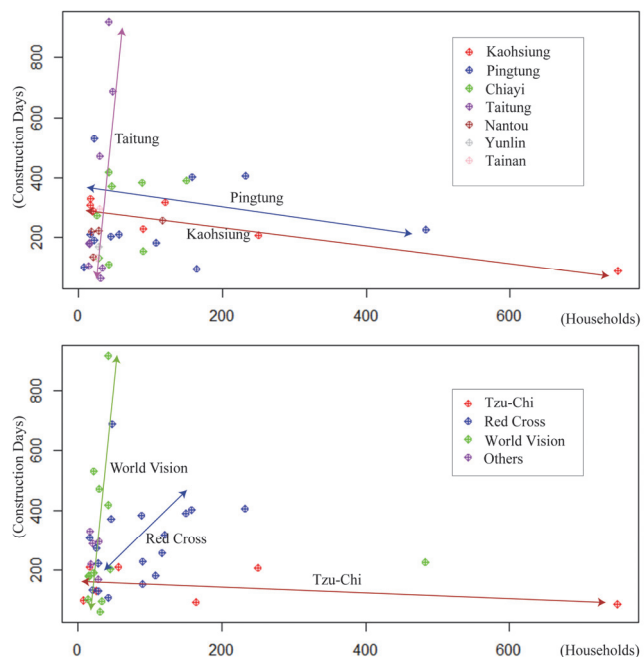


Figure-5 Relationship of days spent constructing, size of settlement, located area, and NGOs

livelihood were maintained. Thus, the land ownership analysis shows that the government's decision-making of the land usage might profoundly influence the connection of the original community and new settlement, which eventually affects disaster-affected households' recovery trajectories. However, Table 3 shows that 82% of the constructions were in government-owned land, which meant the community-centered thinking did not prevail over the budget- and efficiency-centered thinking during the PDR of Typhoon Morakot.

Table-3 The land ownership of the construction land in each area

Area	Kaohsiung	Pingtung	Chiayi	Taitung	Nantou	Yunlin	Tainan	Total
Government-owned land (lot)	7	12	7	5	6	1	2	40
Private land (lot)	2	0	2	3	1	0	1	9
Proportion of the government-owned land	78%	100%	78%	62%	86%	100%	67%	82%

5. Implication and suggestions

This research aimed to compensate for the inadequate literature on the overall PDR analysis of Typhoon Morakot. The analysis considered the spatial and project planning as two main aspects, as well as the communities' perspective. First, the study identified the Kaohsiung and Pingtung regions as the large-scale reconstruction regions. In contrast, the Yunlin and Tainan regions were deemed to be small-size reconstruction sites. It is essential to consider the solidarity of the community while arranging the relocation strategy. Second, the 35 post-disaster settlements were categorized into six configuration types. The research showed that the number of relocated households, planners' ideology, and the participation of communities could vary the result of the settlement configuration. The residents had endorsed the compound type as the preferable planning method among the configuration types. Third, the study found that the Pingtung, Kaohsiung regional governments, and Tzu Chi prioritized the projects' construction speed. Therefore, relatively fewer days were spent on the construction, regardless of the number and size of settlements. However, this research showed that compared to the speedy implementation, the residents cared about how government and NGOs addressed their needs and welfare. There is no shortcut for PDR. Fourth, most of the settlements had been constructed on government-owned land. This sort of decision-making saved monetary resources; however, it undermined the social network between the original community and the new settlement.

According to the findings, this research suggests that the decision-makers and planners should apply compound thinking when implementing post-disaster settlement planning. The NGOs and the local governments need to reconsider whether the construction speed should prevail over the welfare of the relocated households and land ownership issues. Instead of prioritizing speedy solutions, community-centered thinking and inclusive community participation frameworks should be prioritized in the PDR program.

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