

**Translated Paper**

# Field research on cyclone damage and housing reconstruction in Fijian Village—Case study of Navala Village after tropical cyclone Winston

Mari Miyaji<sup>1</sup>  Ayako Fujieda,<sup>2</sup> Sainimere Veitata<sup>3</sup> and Hirohide Kobayashi<sup>3</sup><sup>1</sup>Department of Architecture, Kansai University, Osaka, Japan; <sup>2</sup>Faculty of Humanities, Kyoto Seika University, Kyoto, Japan <sup>3</sup>Graduate School of Global Environmental Studies, Kyoto University, Kyoto, Japan**Correspondence**

Mari Miyaji, Department of Architecture, Kansai University, Yamate-cho, Suita-shi, Osaka 564-8680, Japan.  
Email: miyaji@kansai-u.ac.jp

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**Abstract**

The Republic of Fiji was hit by Tropical Cyclone Winston in 2016, and housing reconstruction was enabled through government support. This study was aimed at observing the impact on housing in a rural village consisting of both modern and traditional housing types, as well as identifying the reconstruction process. The results show that the distribution of materials was delayed, and housing quality depended on local carpenters. We concluded that there was a need to train carpenters, and the reconstruction of traditional houses should be considered. This is to reflect the natural environment in tropical islands and enhance traditional building knowledge.

**Keywords**

cyclone disaster, government support, housing reconstruction, modern housing, Republic of Fiji, traditional housing

## 1. Research Background

Pacific island nations are vulnerable to natural disasters owing to their location in the equatorial low-pressure zone, where cyclones frequently occur. In addition, their vulnerability is compounded by their remoteness from neighboring countries, geography (they consist of a large number of isolated islands), and the small size of their landmass, population, and economies.<sup>1,2</sup> According to the annual World Risk Report published by the United Nations University, four of the top 15 countries in the categories of “Potential for Natural Disasters” and “Global Risk Assessment” are Pacific Island countries (Vanuatu, Tonga, the Solomon Islands, and the Republic of Fiji (Fiji)).<sup>3</sup> Addressing the issue of disaster response is therefore of utmost importance in this region. Owing to the influence of Western countries in the colonial era and subsequent modernization, numerous houses in the Pacific Islands are constructed using tin and concrete blocks. If these houses are damaged by a natural disaster, the recovery time needed is long because of the significant shortage of suitable building materials in the

vicinity of the disaster-affected area. Moreover, the transportation of these materials to remote areas on the islands and mountains constitutes a major problem that significantly impacts the reconstruction.<sup>4</sup> As the price of building materials increases after a disaster, small-scale farmers, particularly in rural areas, lack adequate financial resources to repair and rebuild their houses, thus compelling them to enact emergency measures on their own. This situation induces more vulnerability toward housing than that prevailing prior to the disaster.<sup>5</sup> Moreover, these challenges are more pronounced in developing countries, where the Third United Nations World Conference on Disaster Reduction’s “Sendai Framework for Disaster Reduction 2015-2030” clearly identifies the need for countries and communities to “build back better” to prepare for the future and become more resilient in the recovery, reconstruction, and rehabilitation phases of disasters. Consequently, this framework has been recognized in several regions worldwide and has been incorporated into disaster-recovery policies and plans.<sup>6</sup>

In February 2016, Fiji was affected by Tropical Cyclone Winston (Winston)—a category five cyclone that was a largest

tropical cyclone ever recorded in the southern hemisphere. Forty-four people died, and 62% (540,400 people) of the total population were affected. In addition, 30,369 houses were either partially or completely destroyed<sup>7</sup> and the affected area stretched from the northern part of Viti Levu Island, where the capital Suva is located, to the northeastern islands (Figure 1) in the Fiji group. Immediately after the disaster, the Fijian government began to reconstruct housing units based on “Build Back Safer,” a concept derived from “Build Back Better.” They were supported in this by the Australian and New Zealand governments as well as international organizations, such as the International Federation of Red Cross and Red Crescent Societies (IFRC) and Habitat for Humanity Fiji (HFHF). The Help for Homes (HFH) initiative launched by the Fijian government owing to the large number of damaged housing units, was based on the premise of victim-initiated reconstruction.[Note 1] The initiative included technical training for carpenters and the creation and dissemination of guidelines to enhance the disaster resistance of rebuilt homes

Several researchers and practitioners have advocated the need for disaster recovery to be disaster-centered.<sup>8</sup> However, post-disaster reconstruction is dominated by “donor support” from governmental and international organizations that do not allow disaster victims to intervene. This threatens their independence.<sup>8</sup> Furthermore, despite the diversity of social structures and livelihoods, recovery assistance is unequally distributed owing to geographical and social factors.<sup>9</sup> Therefore, HFH encouraged active survivor-driven rebuilding in island communities, in the hope that survivor-centered reconstruction would represent the way forward.

However, some households, particularly in remote villages, were still living in tents as much as a year after the disaster because of the wide and extensive damage caused by Winston.<sup>10</sup> In contrast, some rural communities started rebuilding their houses through community collaboration[Note 2] using local resources.<sup>11,12</sup> Conversely, the actual application of HFH in community reconstruction has not yet been reported on under these circumstances.

Therefore, this study focused on determining the contribution of HFH toward the development of an appropriate and rapid reconstruction scenario based on the “Build Back Safer” strategy for the post-disaster housing reconstruction model implemented by the Fijian government. Thus, a field survey was conducted in the villages being studied to determine the realities of the proposed implementation; the following

scenarios were envisaged in the guidelines of reconstruction: (1) rapid financial assistance with electronic cards, (2) technical training for carpenters, (3) development and dissemination of guidelines for rebuilding houses, and (4) rebuilding led by the victims themselves.[Note 3] The current study aims to contribute toward the development of appropriate countermeasures for future disasters by verifying the above-mentioned four scenarios in Navala Village, Fiji.

## 2. Damage Caused by Winston and Reconstruction Support

### 2.1 Outline of Winston

A tropical cyclone originated over the northwest coast of the Republic of Vanuatu on February 7, 2016, and gradually developed toward the southwest coast, before forming Winston with winds exceeding 17 m/s (> 60 km/h) by February 10. The cyclone reached the Kingdom of Tonga on February 17, and on February 19, it attained its maximum intensity (category 5), before making landfall in Fiji with a maximum wind strength of 65 m/s (233 km/h) on February 20.

The island of Vanua Balavu on the eastern side of Fiji was affected by Winston first. The cyclone then progressed toward Koro Island in northeast Fiji, after which it crossed the northern part of Viti Levu, the largest island in Fiji, from east to west at an average speed of 65 m/s (233 km/h). The strong winds induced storm surges that caused extensive flooding along the coastal communities, and the water level inland of Koro Island reached up to 200 m. The total damage accounted for approximately 1.9 billion Fijian dollars (FJD) (~100 billion JPY). Among the 30 369 houses damaged across Fiji, 11 989 houses were completely destroyed, and 18 380 houses were partially destroyed. The total damage in the housing sector totaled approximately 770 million FJD. Further estimates suggested that almost 860 million FJD was required to reconstruct the houses, which could take 10 years to achieve along with the restoration of livelihoods.<sup>7</sup> Of this amount, approximately 70 million FJD was invested in the HFH initiative, which is described in Section 2.3 below.<sup>7</sup> In addition to housing, the agricultural sector accounted for approximately 540 million FJD in total damage. The crops that already suffered from water shortages caused by the El Niño phenomenon were damaged further by Winston. Consequently, the livelihoods of farmers in rural areas, mainly in the western part of the country, including the area covered by the current study, were severely affected after the disaster.

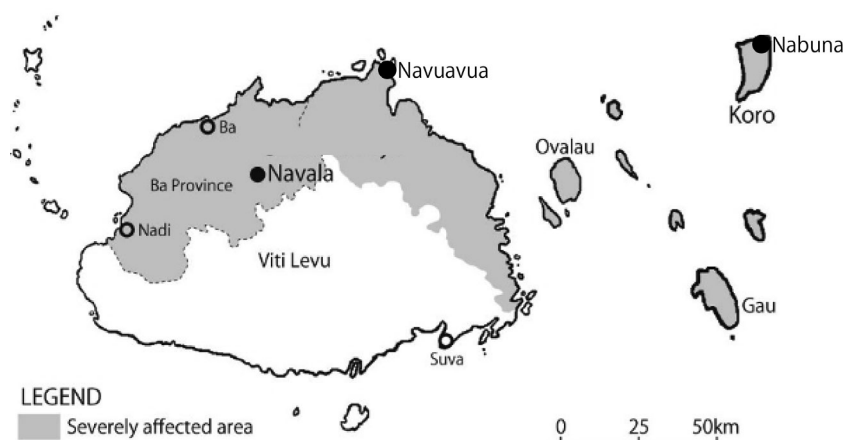


Figure 1. Map of Fiji

Thus, in addition to rebuilding houses the agricultural and farming lands affected had to be rehabilitated, requiring a significant amount of time.

## 2.2 Emergent humanitarian support and reconstruction support framework in Fiji

According to the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) report on emergency and humanitarian aid,<sup>14</sup> the government of Fiji has received approximately US\$ 20 million in emergency and humanitarian aid from countries worldwide. Approximately 85% of the assistance was provided by UN agencies, where 58% was allocated to Fiji government-led projects, 8% to national NGO-led projects, 14% to international NGO-led projects, and 20% to UN agency-led projects. In cooperation with UN OCHA and the above financial support, the government of Fiji established eight clusters for emergency and humanitarian aid (Table 1), which were led by appropriate ministries and agencies. The clusters worked together with the National Disaster Management Office for damage assessment.

Among the eight clusters, the Shelter Cluster—led by the Ministry of Local Government, Housing, and Environment with support from the IFRC—distributed more than 50,000 sets of tents, tarpaulins, and temporary housing kits to approximately 28 000 affected households.

In addition, the IFRC has been working on the “Build Back Safer” initiative to improve the cyclone resistance of the reconstructed houses compared to their pre-disaster conditions. Moreover, the IFRC worked with 800 community carpenters and homeowners to achieve community-driven housing reconstruction through the “Build Back Safer” project by providing training to NGOs and community leaders to lead the rebuilding process. A pilot project for “training the trainer” was launched in early May 2016. The survivors were encouraged to rebuild on their own with the help of the guidelines “Tips to Build Back Safer” which clearly illustrated the process of building a wooden frame house, the number of nails required to install a tin roof, and recommended hardware. This project aimed to induce “community carpentry training” and was included in the HFH housing reconstruction project; however, it could not be implemented owing to a lack of funding.

## 2.3 Reconstruction support of HFH

The HFH initiative was established to assist in the reconstruction of houses affected by Winston<sup>15</sup> by the Ministry of

Economy, and the Social Welfare department of the Ministry of Women, Children, and Poverty Alleviation of the government of Fiji with the cooperation of domestic building material suppliers. The structure of the HFH is shown in Figure 2. This project aimed to provide 7000 FJD to households whose houses were completely destroyed, 3000 FJD to households whose roofs were damaged, and 1500 FJD to households whose roofs were partially damaged by Winston. The e-card provided by the government enabled people to purchase the building materials needed from a list of 11 building material suppliers in the country. This was the first instance of a Fijian government offering e-cards as a post-disaster housing reconstruction project. In addition, the local government conducted a damage assessment to determine the extent of damage across Fiji; however, the victims were allowed to self-declare the amount in their e-card applications based on their own assessment of the extent of damage. Households with an annual income  $\leq$  50 000 FJD and with homes in the affected area, which suffered housing damage and did not receive any housing reconstruction assistance from NGOs or other organizations, were eligible to applying for the e-cards.<sup>15</sup> The original plan intended to provide benefits to approximately 30 000 households<sup>13</sup>; however, interviews with Ministry of Economy officials revealed that 37 100 households had received e-cards as of March 2018, thereby exceeding the initial plan.<sup>16</sup> Moreover, construction guidelines developed by the shelter cluster were distributed to the affected people along with the guide to apply for the e-cards (Figure 3).

As the support for HFH was limited to the supplying of building materials (including transportation to the affected areas), the construction costs were to be borne by the victims and survivors themselves; therefore, people chose to hire carpenters at their own expense or build their own houses. In comparison, Ba provincial officials stated that the housing reconstruction aid provided after Cyclone Evan in 2012 (when 8497 houses were damaged, including 2094 houses that were completely destroyed) included the cost of hiring carpenters. The total cost of assistance provided to each household amounted to 14 000 FJD, which is twice the amount provided for the post-Winston reconstruction project. However, the number of houses damaged by Winston was approximately five times more than by Evan, and the extensive area affected made it difficult to provide the same amount of aid to all the affected households. Therefore, the cost of hiring carpenters could not be covered.

**Table 1.** Clusters after cyclone disaster in Fiji

Cluster	Fijian Government	International Organization	Support Organization
Water sanitation and Hygiene	Min. of Health and Medical Services	United Nations Children's Fund (UNICEF)	UN Office for Coordination of Humanitarian Affairs (UN OCHA),
Food Security and Livelihoods	Min. of Agriculture	Food and Agriculture Organization	Fijian Council of Social Services
Education	Min. of Education	UNICEF, Save the Children	
Emergency Telecommunication	Min. of Information and Communication	World Food Program	
Logistics	Fiji Procurement Office	World Health Organization	
Health and Nutrition	Min. of Health and Medical Services	World Health Organization	
Safety and Protection	Min. of Women, Children and Poverty Alleviation	UNICEF, UN Women	
Shelter	Min. of Local Government, Housing and Environment	The International Federation of Red Cross & Red Crescent Societies	

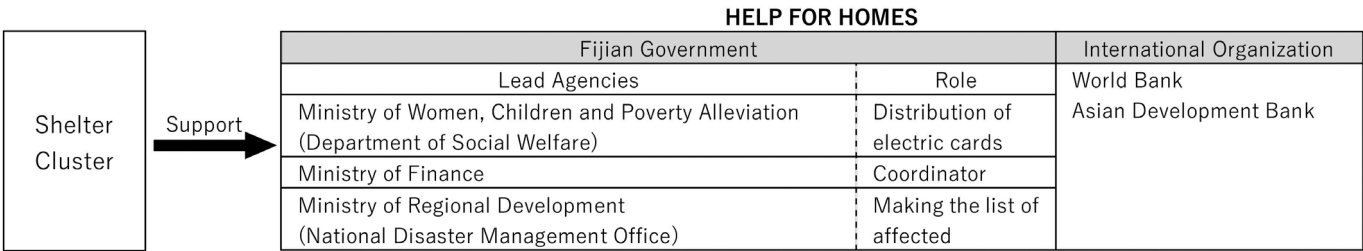


Figure 2. Structure of HELP FOR HOMES

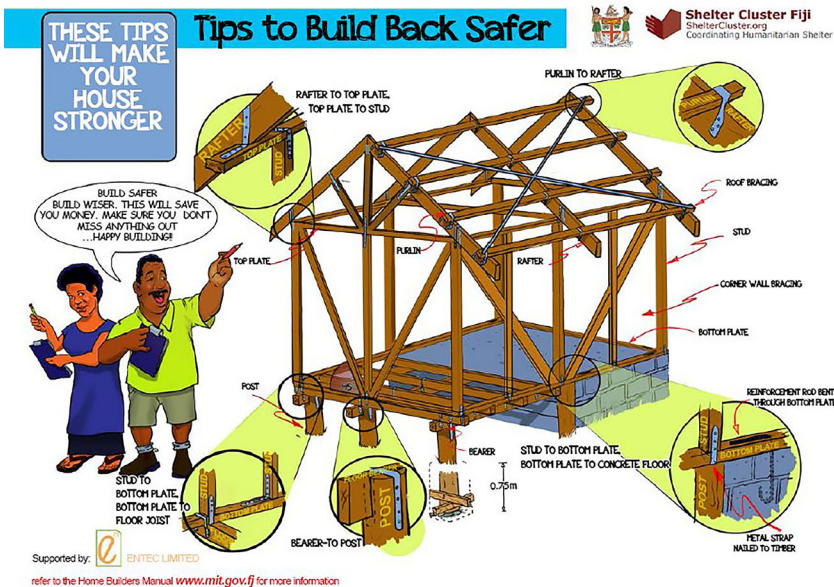


Figure 3. Tips to Build Back Safer (Ref: Shelter Cluster)

2.4 Progress of HFH in regional areas

A broad-based survey conducted to determine the actual status of HFH housing reconstruction revealed that the village of Nakoroboya had received HFH-supported building materials but was unable to rebuild the houses owing to the lack of carpenters in the village. In September 2017, eighteen months after the Winston disaster, HFHF built a house for a disabled child. Thereafter, the reconstruction of houses using HFH construction materials began after HFHF trained 20 village volunteers in house construction techniques. Specifically, it was planned to rebuild 22 HFH houses. As of March 2018, 15 housing units were completed using cyclone strips, as recommended by the construction guidelines (Figure 4).

In the village of Nabuna on the island of Koro, the construction materials from HFH were delivered, however, the housing recovery process was delayed as there was only one carpenter in the village.

3. Research Sites and Methodology

The current study is based on data<sup>11,16,17</sup> obtained from four periods of fieldwork conducted from March 2 to 15, 2017, September 5 to 27, 2017, March 1 to 21, 2018, and September 11 to 28, 2018.



Figure 4. Cyclone Strap

The study site was Navala Village (Navala), which is located in the mountains in the interior of Ba Province, northwest of Viti Levu, the largest island in Fiji. Navala was selected as the

site for this study because it was severely damaged by Winston. Moreover, it was the only village in Fiji where a majority of the houses were Bure, therefore, the authors conducted a field survey of Bure[Note 4] construction techniques.<sup>19</sup> There were 141 households with approximately 800 people residing in the village within six clans, who were mainly engaged in small-scale farming (e.g., cassava). Of the 117 valid responses to the questionnaire, 99 (84%) stated that agriculture was their primary engagement. In Fiji, housing patterns have changed owing to the influence of Western colonial countries and the consequent modernization, and the percentage of traditional Bure houses has decreased to 1.9%.<sup>20</sup> Therefore, this case study is a valuable resource for the conservation of traditional housing. The village received cash income from tourist entrance and accommodation fees,<sup>21</sup> which was mainly used for village development projects. Among the 141 houses in Navala, 32 houses were completely destroyed, 30 were partially destroyed, and no casualties were reported.<sup>22</sup> Interestingly, the houses in Navala were repaired with community collaboration before any external assistance was received post-Winston.<sup>12</sup> Currently, the number of modern houses is increasing rapidly with the support received from the government's HFH initiative.

For the current study, we conducted an exhaustive survey of the 141 village houses through an interview with the village headman (*Turaga ni koro*). In addition, a field survey was conducted of the houses along with 118 household interviews (72 households in March and 46 households in September 2018) to accurately determine the extent of damage to houses in Navala and the reconstruction progress. The households were interviewed using a questionnaire. In addition, interviews were conducted with Ba provincial government officials.

## 4. Damage by Cyclone Winston in Navala

### 4.1 Cyclone damage in Ba Province

The Ba Province is located in the northwest region of Viti Levu, with an area of 2634 square kilometers and a population of approximately 250 000 people (31.2% rural), making it the most populous of the 14 provinces in Fiji. The Western Division, including Ba, was the region most severely affected by Winston, where Ba accounted for approximately 34% of the total damage (660 million FJD), the largest proportion for any Fijian province. Of the 47 533 housing units in Ba Province before Winston, 3494 were completely destroyed and 4241 were partially destroyed.<sup>7</sup>

### 4.2 Evacuation and emergency period

Winston arrived at Navala Village after sunset on February 20, 2016. According to the village headman, no cyclone warning had been delivered to the village. The headman himself had confirmed the path of the cyclone in advance by radio, and immediately informed the residents, telling them to evacuate to the designated evacuation centers (a school and church). The electricity supply to the village was interrupted, and the villagers had to evacuate in the dark amidst the sound of the tin roofs on the modern houses vibrating in the strong winds.

Approximately 90% of the residents evacuated to the designated shelters, except for one instance, where a family deemed their newly built Bure[Note 5] to be safe. They decided to seek refuge in the Bure along with four or five neighboring families. The day after the disaster, almost 500 people remained in the shelters, and the people whose houses had suffered less damage returned to their homes. The evacuation centers were managed by the village committee,[Note 6] where

food and relief supplies were distributed to families. Although 12 families continued to live in sheltered schools and churches for up to a month after the disaster, school classes resumed 2 weeks after the disaster.

Following the arrival of Winston, the bridge over the river at Navala was flooded. Therefore, the village headman and school principal swam across the river to report to the Ba Provincial office regarding the damages and casualties in the village. For up to a month after the disaster, Fijian military personnel delivered external assistance (Table 2) to Navala.

### 4.3 Housing damage due to Winston

According to a report on housing damage by the Ministry of iTaukei Affairs, 32 out of the 141 houses in Navala were completely destroyed, and 30 houses were partially destroyed by the Winston disaster.<sup>22</sup> However, according to a questionnaire survey (119 households provided valid responses), 25 houses (21%) were "completely destroyed" and 19 houses (16%) were "severely damaged;" 60 houses (50%) had minor damage, and 15 houses (13%) had no damage. Overall, 85 households (71%) reported damaged roofs. The report is summarized in Table 3.

The results of the questionnaire along with the visual inspection and interviews conducted during the field survey showed that 26 Bures (a quarter of the total number of Bures) were completely destroyed by Winston, indicating that around a quarter of Bures are at risk of being destroyed by such tropical cyclones. The difference between the report from the Ministry of iTaukei Affairs and that of the current study was attributed to the detailed information gathered per household (119 out of all 140 households surveyed except 1 household), although 21 households could not be surveyed.

Figure 5 shows a Bure with a roof that was damaged by Winston, and Figure 6 shows a Bure with a completely destroyed roof. The residents of Navala were aware that the roof frame was mounted on a pillar, and as the pillar collapsed under strong winds, it tilted and descended slowly, thereby leaving the roof frame intact and creating a space for survival without the need for evacuation. This behavior was witnessed by several families who sought refuge in Bures. Surprisingly, the roof structure remained intact in the Bures that were completely destroyed, but the pillars were in a state of collapse. In contrast, the tin sheets used for constructing the roofs and walls of modern houses were either blown away by the strong winds or collapsed together with the structural materials, resulting in the injury or death of the people seeking refuge inside (Figure 7). Furthermore, the tin roofs of newly constructed modern houses were found scattered around Navala (Figure 8). Numerous residents stated that tin roofs are prone

**Table 2.** International Aid in Navala

Date	Organization	Activities
One week after the cyclone	IFRC	Damage assessment
Two weeks after the cyclone	IFRC	Provided food, bed clothes, vinyl sheets, etc.
One month after the cyclone	China aid	Provided tents
	New Zealand Aid	Provided food
	UNICEF	Provided hygiene and sanitary kits to children, tents to kindergarten, education kits to school



Table 3. Houses damaged by Winston in Navala

	Completely destroyed	Severe damage	Minimal damage	No damage	Total
Traditional house Bure	23	16	48	7	94
Modern house	2	3	12	8	25
Total	25	19	60	15	119

to shattering under high winds and may even injure people, whereas thatched roofs are much safer.

5. Housing Reconstruction After Winston in Navala

Housing reconstruction in Navala was divided into two phases: (1) construction of temporary housing and repair of damaged houses as an emergency response within 1–2 months of the disaster, and (2) the reconstruction of houses that started several months after the disaster. The project can be further divided into three categories: (1) reconstruction and repair of new industrial material houses supported by HFH, (2) reconstruction and repair of modern houses built before Winston, and (3) reconstruction of traditional Bure houses. In all cases, the construction and repair works were carried out mainly through community-based collaborations. Drawings and photographs of the house types in Navala are shown in Figure 9, and Figure 10 illustrates the layout of the houses as identified in the field survey in September 2018. As shown in Figure 10, houses in rural settlements of Fiji generally have an outdoor kitchen building that is separate from the main house. Therefore, the number of houses damaged represents that of the main house, whereas the number of houses reconstructed under the HFH initiative is based on the number of main houses and kitchen buildings combined, as residents rebuilt the kitchen building separately as well.

The following section summarizes the details of each phase of housing reconstruction.



Figure 5. Roof of traditional house (Bure) damaged by Cyclone Winston (Ref: Ba office)



Figure 6. Traditional house (Bure) completely destroyed by Cyclone Winston (Ref: Ba office)



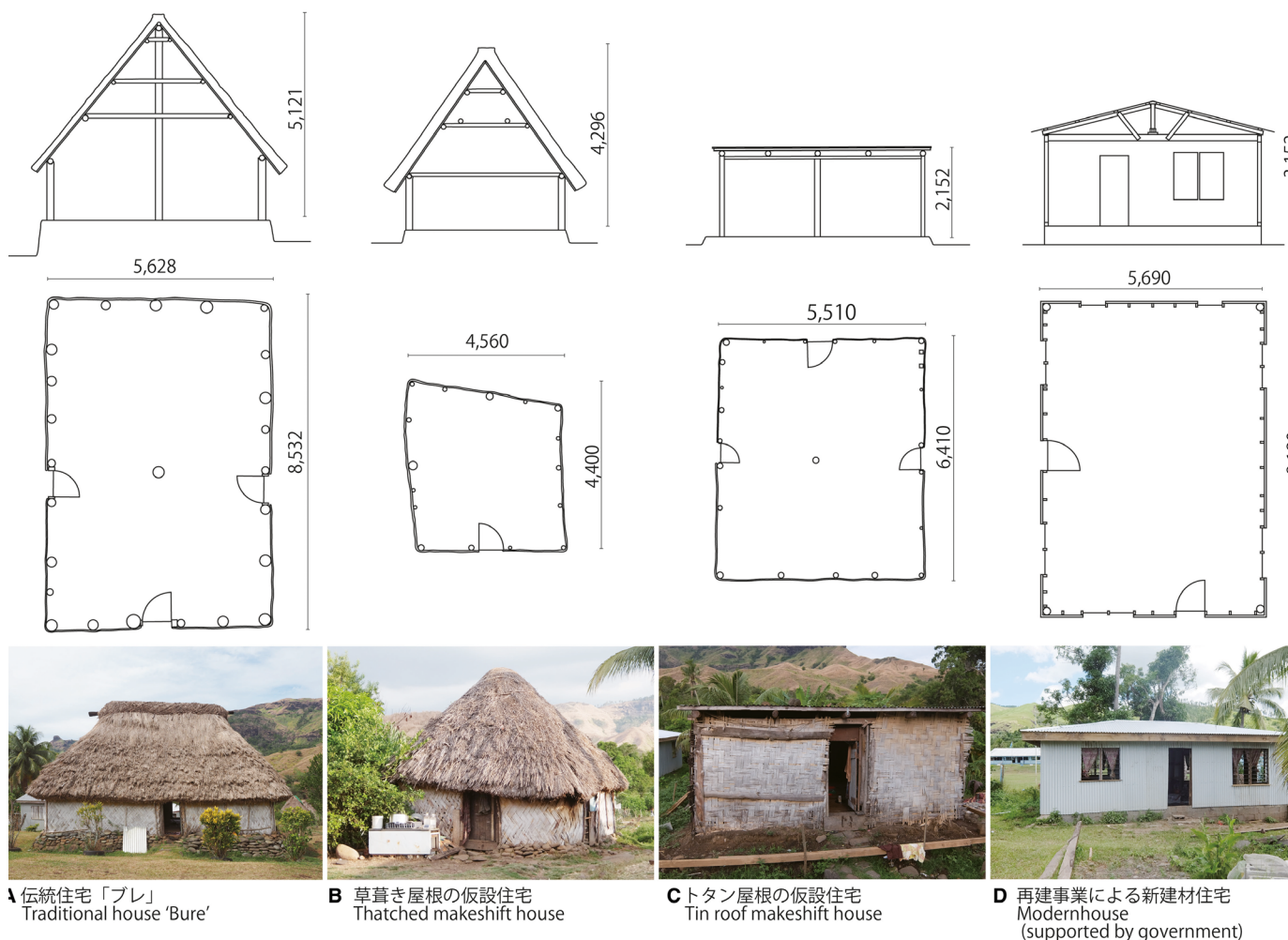
Figure 7. Modern house completely destroyed by Cyclone Winston (Ref: Ministry of Education)



Figure 8. Wall of a modern house damaged by Cyclone Winston (Ref: Ba office)

5.1 Emergency period before housing reconstruction

During the first week after the disaster, the villagers collected building materials that were blown away by strong winds. The roofing materials were collected and bundled together for reuse in the repair work. Over the following two months, the villagers worked together to repair a total of 120 damaged houses, including both modern and Bure houses. In particular,



**Figure 9.** Housing type in Navala village

40 Bures required roof patching and repairs to mend the damaged parts. Twenty-two groups of five men worked together during this period—each working on different days for three days a week—to help rebuild their lives and free up time for agricultural work.

During this time, the villagers sought temporary accommodation in tents provided by the Chinese government, kitchen structures that remained undamaged from the cyclone, houses of relatives, and temporary shelters that they built themselves. At the time of the survey in September 2017, we observed that certain tents were still being used as sleeping quarters, but in March 2018, we found that the remaining tents were being used as storage or cooking areas.

Temporary houses can be categorized into two types based on their building materials: (1) temporary houses made of conventional materials such as wood and bamboo for the walls and thatched roofs (Figure 9B), and (2) temporary houses made of modern materials such as wood, bamboo, or tin for the walls, and tin roofs (Figure 9C), where the building materials were reused from completely or partially destroyed houses. The temporary houses built in Navala with conventional materials were approximately 4 m × 4 m, which is less than one-third of the size of an average Bure (9 m wide and 5.5 m deep), as shown in Figure 9A. This is mainly because the foundation of the

original house (*Yavu*) was left vacant for reconstruction, while the temporary housing structure was built on vacant space beside it. The other temporary houses were built similarly, and they were smaller than the original houses. In addition, these temporary houses were built by homeowners within three to seven days and not by community collaboration.

## 5.2 Reconstruction housing before HFH

In the on-site survey conducted in September 2017 (18 months after the disaster), 37 out of 119 households (31%) responded that major repairs or reconstructions were still needed, and 12 households had already started major rebuilding or repairs. In addition, there were eight new housing units and four new Bures. Overall, three Bures were rebuilt with community collaboration, and only one house was rebuilt by the relatives of the occupants; the three households whose houses were rebuilt with community collaboration covered their rebuilding costs (e.g., food for workers) at their own expense. Five households reported that they had rebuilt their new houses with the assistance of carpenters belonging to the community, two households used carpenters from outside the community, and one household rebuilt on their own. Moreover, four households paid for the materials themselves, three households received external assistance, and one household reported that they



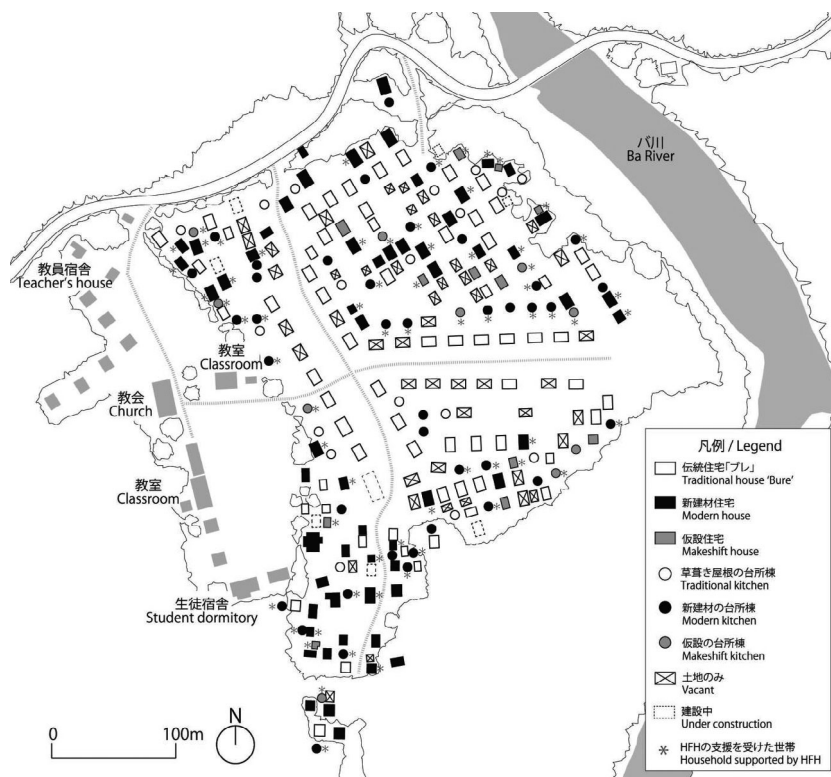


Figure 10. Housing map in Navala village in September 2018

reused materials from a damaged house. The distribution of external assistance included one household that received support from the Catholic League and two from the Department of Social Welfare.

### 5.3 HFH in Navala

In Navala, 41 of the 141 households received e-cards with 7000 FJD, 28 received 3000 FJD, and 28 received 1500 FJD. The carpenters in the village estimated the cost of the building materials and informed the residents, who thereafter went directly to the four designated hardware suppliers to place the procurement order for the materials. Owing to extensive damage, there was a shortage in the supply of building materials across the country. In general, building materials such as tin and concrete blocks arrived in small batches every week, and consequently, the construction progressed gradually. All 97 e-card beneficiaries (households) received their ordered building materials in August 2018, but only 62 of the 97 households had completed the projected reconstruction in the following month (September 2018), and the remaining 35 households were yet to completely rebuild their homes. This was partly because the households that received either 3000 or 1500 FJD e-cards were compelled to pay for any shortfall of building materials at their own expense. They needed time to accumulate adequate savings before they could start to rebuild their houses and repair their roofs. The process of HFH, from application to reconstruction, in Navala is summarized in Table 4.

A carpenter was hired for the construction of modern houses, and the community worked together to construct houses under his direction. In Navala, there are four carpenters who graduated from a vocational school and obtained a license, and three of them were engaged in the reconstruction of houses with new

building materials. Seven people, including carpenters, require approximately three weeks to build a house under normal circumstances. However, the construction took much longer than expected because the building materials were delivered in small batches. As mentioned earlier, HFH did not cover the cost of hiring carpenters; thus, it was necessary for the households to save up for the cost of hiring carpenters apart from the food required for the workers participating in the collaborative reconstruction. In Navala, a carpenter is remunerated with 700 FJD or a cow from each household on his hiring, and the households that can afford it are the first ones to get rebuilt.

The houses supported by the reconstruction project in Navala are depicted in Figure 9D. The new houses constructed under the

Table 4. Progress of HELP FOR HOMES (HFH) in Navala

Month	Activities of HFH
February 2016	Tropical Cyclone Winston hit the village Village head and school principal reported cyclone damage to the local government
March 2016	Damage assessment by the local government
May 2016	Each household applied to HFH
August 2016	Each household received e-cards and ordered construction material
April 2017	Each household received materials in batches and started reconstruction
September 2017	12 houses were completely constructed
March 2018	52 houses were completely constructed
August 2018	All materials were distributed
September 2018	62 houses were completely constructed



reconstruction project were actually built on the foundation of the original house and thus were the same size as the original house. The structure was constructed using wood, the walls were of tin only or a combination of tin and concrete blocks, and the roof was made of tin. The homeowner can select any combination of material for the walls. There were no distinct standards for constructing new houses, and the ratio of cement to water in the concrete, roofing, and bracing was based on the experience of the carpenter. Moreover, the construction guidelines “Tips to Build Back Safer,” attached to the application guide that was distributed with the HFH e-card application, were available in Navala. However, no new houses were identified that were rebuilt using the new building materials from this reference.

#### 5.4 Reconstruction of traditional Bure

According to the questionnaires collected in the 2017 field survey (118 valid responses), 88 households (75%) stated that Bures were safer than modern houses, 19 households (16%) stated that modern houses were safer than Bures, and the remaining 11 households (9%) said that they were neither safe nor unsafe. Among the 118 households, 101 (86%) responded to the question on the strength of Bures, reiterating that Bures were resistant to cyclones.<sup>Note 5)</sup>

Immediately after Winston, 14 of the 26 completely destroyed Bure houses were scheduled to be rebuilt in April 2017.[Note 7] However, contrary to the results of the questionnaire-based survey, the construction of modern houses was prioritized through the rebuilding project because the construction of a new house required only three months, including the procurement of building materials. Bure construction required a longer period because the materials used to be transported on the river that flows through the foothills of the village, however after Winston, they used trucks and the transport costs were high. As of September 2018, the Bure reconstruction was postponed to April 2019, and community meetings<sup>Note 7</sup> agreed to reduce the number of Bure units for reconstruction from 14 to 10.

Nonetheless, the survey conducted in March 2018 confirmed that in parallel with the reconstruction of new housing units, the Bure roofs were being repaired with community collaboration by reusing roofing materials from the collapsed Bures. As the village chief's residence[Note 8] was a Bure and the roof had begun to leak, a community meeting<sup>g</sup> decided to repair the Bure roof at short notice. The interviews with the residents indicated that there were 10 people involved in the collaborative work, and the roof replacement took four days to complete. Subsequently, during a site visit in September 2018, two more roofs were replaced, and another roof was scheduled to be replaced by the end of the year. The roof replacement on the chief's Bure was made from reused old Bure roofing, whereas the roofing materials for the three remaining houses were

obtained from the forest owned by the village. Further interviews with the residents indicated that the forest resources were damaged after the Winston disaster, but after two years, the forest resources had recovered sufficiently to be used for replacement of the roofing and structural materials for reconstruction; in addition, they would be ready to rebuild Bures in 2019.

#### 5.5 Progress of housing reconstruction in Navala

The implementation of the HFH reconstruction project with modern houses in Navala required a longer time than expected owing to the shortage of stock and availability of building materials across Fiji. However, the reconstruction work in Navala was quicker than that in other villages because of the presence of carpenters there. Moreover, the community continued working together (village cooperation) as a norm in their everyday lives. Modern houses were actually damaged by Winston because of the weaknesses in the joints between the tin roofs and house structures owing to nail lengths not being specified. In addition, a weakness existed between the concrete foundations and the structural materials of the houses on stilts, acting in conjunction with the deterioration of the wooden columns because of moisture as they were built directly into the ground floor.<sup>24</sup> Although the government had distributed construction guidelines for the reconstruction of new houses under assistance from HFH, the interviews revealed that the village carpenters built houses based on their own experience as carpenters. In the initial days after the disaster, 14 of the 26 Bures destroyed by Winston were planned for reconstruction. Despite the convenience, the residents were aware of the danger of building a tin roof against a cyclone. However, the reconstruction of a Bure requires a long time period because of the required preparation, such as collecting the material, processing the trees, and communicating between workers. Still, the number of new houses built under the HFH initiative is increasing rapidly in the villages (Table 5 and Figure 11). There were four times as many modern houses built compared to those before the cyclone, but the number of newly constructed Bures decreased.

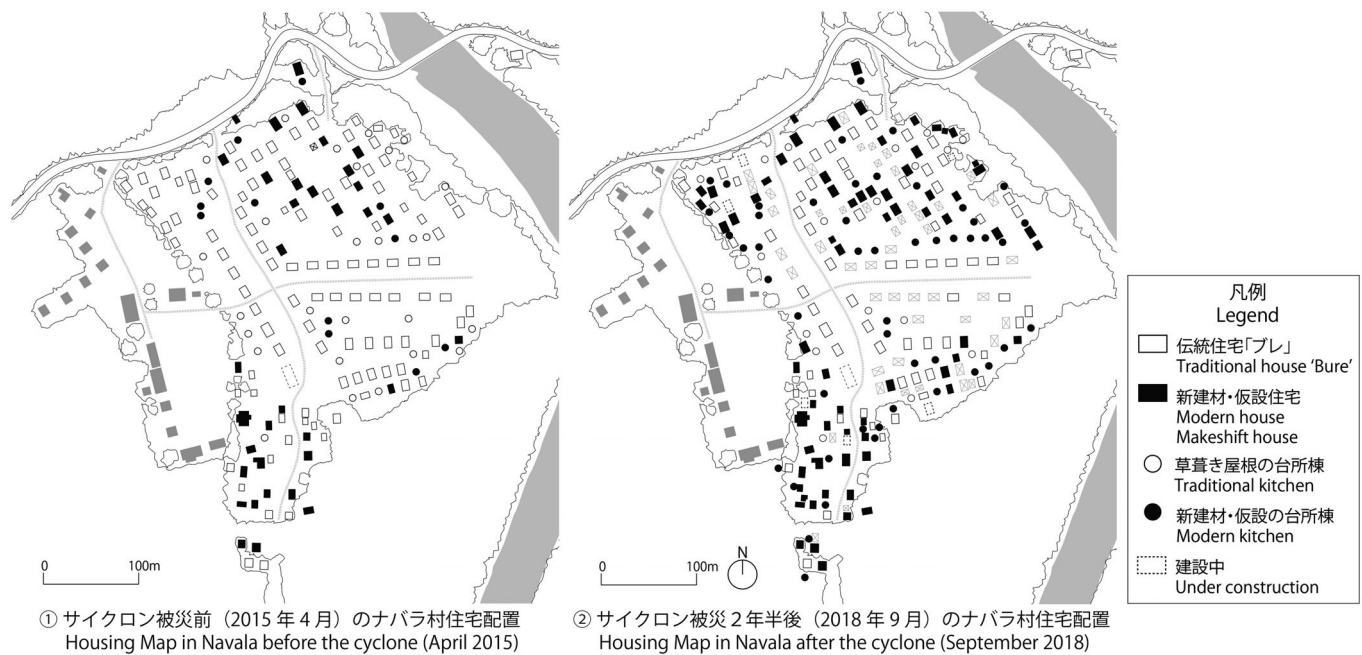
## 6. Conclusion

In this study, we describe the HFH project implemented in Navala in Fiji following Winston. The actual conditions of each project scenario were as follows:

(1) Rapid financial assistance for reconstruction using e-cards. Funding for the building materials was initiated three months after the disaster, and 37,100 households across Fiji received their e-cards within two years of the disaster, indicating that the prompt provision of e-cards had been achieved. In Navala, an e-card was applied for and received within three months of the disaster.

**Table 5.** Housing in Navala before and after the cyclone

	Before the cyclone (April 2015)		One year after the cyclone (March 2017)		Two years after the cyclone (September 2018)	
	Main house	Kitchen	Main house	Kitchen	Main house	Kitchen
Total	141	72	141	58 (−14)	144 (+3)	88 (+30)
Traditional house, Bure	102	21	74 (−28)	19 (−12)	68 (−6)	17 (−2)
Modern house	31	10	24 (−7)	11 (+1)	53 (+29)	44 (+33)
Makeshift house	—	21	10 (+10)	18 (−3)	4 (−6)	16 (−2)
Tent	—	—	11 (+11)	—	0 (−11)	—
Vacant land	8	10	19 (+11)	10	19	11 (+1)



**Figure 11.** Housing map before and after the cyclone in Navala village

However, there was a stock deficit of building materials across Fiji owing to the extensive scale of the damage, which caused delays in the transportation of the materials. In Navala, the first building materials were delivered one or two months after Winston, and it took over a year to complete the delivery of all the materials.

(2) Technical training for carpenters, leading to housing reconstruction.

The technical training for carpenters was initially planned under the HFH initiative by the Ba Provincial office in collaboration with HFHF and Fiji National University; however, the training could not be implemented owing to the lack of project funds. In Navala, three carpenters were involved in the reconstruction of houses and were able to complete the construction. However, in certain cases, such as Nakoroboya, the lack of carpenters prevented the reconstruction of houses combined with the delay in the delivery of materials. In addition, as carpenters are not always present in every rural community, technical training should aim to include volunteer residents, similar to the workshops conducted by HFHF.

(3) Dissemination of guidelines for reconstructed housing  
“Tips to Build Back Safer” is a set of construction guidelines that were designed to ensure disaster resistance of the disaster-affected reconstructed houses. Although the guidelines were meant to be distributed at the instant of application for the e-card, the residents in Navala did not receive them. This was evident from the questionnaire-based interviews conducted with the villagers, indicating that none of the rebuilt houses appropriately fulfilled the Fijian government’s Build Back Safer standards; therefore, continuous promotion is required to enforce the intended guidelines.

(4) Promotion of survivor-led housing reconstruction

The culture of community collaboration is deeply rooted in Fiji villages, particularly in Navala, where traditional Bure houses were repaired, rebuilt, and maintained consistently. In addition, the Fijian government intended to promote the survivor-led

housing reconstruction approach, as this culture is strongly present among rural communities. Consequently, villagers can reconstruct their houses by themselves. As reconstruction by collaboration was confirmed in the wide-area survey, the potential of disaster victim-led housing reconstruction in Fiji was determined to be exceedingly high.

In addition, the support provided by the HFH initiative for the reconstruction of houses was limited to modern materials and was not applicable to the reconstruction of houses using local resources, such as those used for Bure. Moreover, the reconstruction of Bure was postponed because of the priority applied to the reconstruction of houses using the new building materials (from HFH support). We believe that the HFH reconstruction based on the policy of “Build Back Safer” should consider the safety of the houses along with its impact on the living environment and culture of the community.

Thus, this study examined the HFH project by detailing its actual implementation scenario in a village. The results revealed the detailed scenario of the study village, and conclusions can be drawn from the Navala case study. The results and corresponding conclusions may vary for other villages in the country. However, the challenges and potential of HFH discussed in this case study are vital for the development of future reconstruction scenarios.

We intend to continue to conduct a long-term field survey on the impact of the reconstruction of modern houses with new building materials compared to the materials used for the traditional Bure in Navala. Furthermore, we seek to expand the target area and include other villages to verify the disaster resistance of modern houses reconstructed under the guidance of the carpenter in each village.

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## Disclosure

The authors have no conflict of interest.

## Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Notes

Note 1) The Fijian government announced the implementation of the HFH housing reconstruction projects based on an owner-led reconstruction approach. Specifically, they planned a scenario involving residents who would rebuild their homes with financial assistance provided by the Fijian government to purchase the building materials.<sup>7</sup> This has been referred to as “survivor-led reconstruction”.

Note 2) Subsistence production, which is not dependent on the fiscal economy, is based on community collaboration in rural Fijian villages, locally termed *Solesolevaki*. Moreover, houses were constructed through community collaboration.

Note 3) The project scenario is summarized in four scenarios<sup>7,15</sup> and interviews with Fijian government officials.

Note 4) A traditional Fijian house is called a Bure, comprising a wooden thatched roof and a single room. Originally, Bure referred to sleeping quarters or community houses where unmarried men lived in groups away from women and children, but nowadays, wooden thatched-roof houses are collectively referred to as Bure.<sup>24</sup>

Note 5) The questionnaire-based interviews with residents indicated that Bure houses built less than five years ago had not deteriorated over time and were believed to be resistant to cyclones. Two Bure houses built in 2015 prior to Winston were identified, and the questionnaire revealed that several households were evacuated to these houses.

Note 6) In Navala, there is a village committee comprising the village head and representatives of six tribes for the management of the village, with a total of 12 members.

Note 7) In Navala, a monthly meeting is held in principle for all members of the community to discuss and finalize decisions on community collaboration, village tourism, school management, and other issues related to the village, such as the construction of the traditional Bure house. The village committee decides on the agenda for village meetings before the scheduled meeting.

Note 8) Apart from its political structure, Fiji has a Polynesian social structure based on patrilineal descent with hereditary chiefs (called chiefs) leading the tribe. In addition, a hierarchy of chiefs exists and the highest-ranking chief serves as the village chief, who has been referred to as the “chief” in this study.<sup>1</sup>

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