The Evolution of Localized Housing Recovery in Japan

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Abstract. Localized disaster recovery housing refers to housing made using local resources (materials, people, and skills). Using local resources to build temporary and permanent housing for people who lost their homes helps revitalize the disaster-affected area by contributing to the local economy and supporting local businesses. In the context of Japan, localized housing recovery can be understood as using some or all of the following: timber materials; traditional/local wood construction methods; and local companies and craftspeople. The term 'localized housing recovery,' chiikigata juutaku fukkou in Japanese, was first used in the recovery of the Yamakoshi area of Nagaoka City after the 2004 Chuetsu Earthquake, where local timber and carpenters were included from the post-disaster planning through rebuilding phases. While wooden temporary housing was rarely used since the 1995 Great Hanshin Earthquake in Kobe, after the 2011 Great East Japan Earthquake a “localized type” of construction used local natural resources for the construction of wooden temporary housing or recovery housing, including over 6,000 units of wooden temporary housing in Fukushima Prefecture alone. A similar approach was used after the 2011 Flood Disaster in the Kii Peninsula. This paper provides an overview of the evolution process of this localized recovery housing in Japan.

1. Introduction

Due to the various benefits for residents and the affected areas, experts often promote the use of local building materials in housing reconstruction after natural disasters [1, 2]. Sourcing materials locally contributes to the economic recovery of the affected area, supports local businesses, and can reduce time needed to start the reconstruction process [3]. Environmental impacts are reduced by shorter transportation distances to get materials to the site initially and in the life cycle of the building as future repairs can also be made using locally available materials. This in turn benefits residents, as repairs will be more affordable (or may be done by residents themselves). Using local materials also supports traditional craftspeople and the cultural heritage of the region, and traditional housing designs can contribute to a comfortable living environment for disaster survivors.

However, especially in using local timber for reconstruction of wooden houses, there may be challenges such as material scarcity or risk of accidentally supporting illegal logging/environmentally damaging impacts, as occurred in Aceh among the donor-driven housing reconstruction projects after the 2004 Indian Ocean Tsunami [4]. Humanitarian shelter providers from outside the disaster area may also make mistaken assumptions that materials will be locally available, or that the use of timber is the best environmental or economic choice even when this is not the case [4, 5]. However, this is not a concern in Japan, where there is a well-established and well-regulated system for all aspects of forestry management and timber production.

The use of local timber materials in post-disaster housing reconstruction in Japan occurs within the specific context of a traditional wood construction culture and local timber industry, paired with
specific government-driven approaches to disaster recovery. With houses traditionally built from wood, Japan has a long history of timber production, construction, and carpentry. Even today, wood construction is the standard for building detached housing, although the process has been modernized with the use of pre-cut timbers that can be assembled more quickly than in traditional carpentry. While the construction process has modernised, traditional modules of wooden housing construction are still visible.

Japan also has a distinct post-disaster housing reconstruction context. Although the Japanese government accepts some international support after disasters, recovery projects are almost exclusively funded by the national government. With a long history of disaster experience, Japan has well-established disaster recovery policies that have been modified over time. Japanese post-disaster housing recovery occurs within a clearly delineated process for the provision of temporary housing and permanent housing support. Implementation of localized housing recovery in Japan, therefore, integrates the use of traditional timber construction into the context of housing recovery shaped by government-driven reconstruction policies. Initiatives supporting localized housing recovery include temporary housing and self-funded (by homeowner) and government-funded construction of permanent housing.

Within the context of Japanese post-disaster recovery, this paper considers that ‘localized housing recovery’ uses a combination of timber materials; traditional/local wood construction methods; and local companies and craftspeople. The term ‘localized housing recovery,’ chiikigata juutaku fukkou in Japanese, was first used in the recovery of the Yamakoshi area of Nagaoka City after the 2004 Chuetsu Earthquake, where local timber and carpenters were included from the post-disaster planning through rebuilding phases. After the 2011 Great East Japan Earthquake, there was a significant increase in a localized type of construction using local natural resources for the construction of wooden temporary housing or recovery housing. Localized housing continued to develop after subsequent disasters including the 2011 Flood Disaster in the Kii Peninsula. Following an overview of Japanese post-disaster housing reconstruction support policies and projects, this paper traces the implementation and development of localized disaster housing recovery in Japan.

2. Purpose and Methodology

Although the use of local materials is commonly supported by international humanitarian agencies and housing recovery experts, there are few studies explaining the Japanese approach and experience with localized housing recovery in international literature on housing reconstruction. The purpose of this paper is to clarify the features of Japanese localized housing recovery and chart the development of this approach through the implementation of key cases.

Through an examination of the factors that contribute to the creation of these projects and their connection to traditional construction methods and local materials, this paper considers the necessary conditions to support and improve the implementation of localized housing recovery, along with lessons from Japan that may be relevant to other countries. This paper relies on a review and synthesis of key literature and data about localized disaster recovery housing in Japan, and also draws on the authors’ direct involvement in the promotion of localized housing and implementation of related cases.

3. Japanese System for Post-Disaster Housing Reconstruction Support

With frequent exposure to natural hazards, Japan suffers repeated disaster damage and has established policies and systems to support temporary and permanent housing reconstruction. The national government coordinates and funds housing reconstruction in Japan, with prefectural and municipal governments having clear roles for planning and implementation of recovery projects. Unlike countries where international agencies provide the majority of housing reconstruction support through donor-driven reconstruction projects, government policies dictate each phase of housing recovery and reconstruction in Japan. In the case of a major disaster, after an initial evacuation phase where survivors stay for days, weeks, or even months in evacuation centers such as schools or municipal
buildings, housing recovery support focuses on the provision of temporary housing, followed by projects supporting permanent housing reconstruction.

3.1. Temporary Housing
The Act for Support of Disaster Victims stipulates the provision of temporary housing by prefectural governments to disaster survivors at no cost. According to this law, temporary housing is designed to be used for 2 years, and therefore does not require construction to the same building standards as typical housing construction. However, the use of temporary housing can and has been extended — more than 7 years after the 2011 Great East Japan Earthquake there are still tens of thousands of people living in temporary housing [6]. Most temporary housing units are smaller than 30m.²

3.2. Permanent Housing: Private Reconstruction, and Public Housing Provision
For the reconstruction of permanent housing, recovery projects mirror the Japanese government’ two-tiered approach to housing policy: while the majority of households are expected to secure their own housing in the private market, public housing is provided as welfare housing for those who cannot access this market [7]. After the 1995 Hanshin Awaji Earthquake in Kobe, the government provided very little support for private housing reconstruction, focusing instead on the provision of public housing. In response to the difficulties that this caused for life recovery, subsequent revisions to the Act for Support of Disaster Victims in 1999 allowed families with completely damaged houses to receive up to 3 million yen ($30,000 US) compensation from the national government (local governments can add to this) that can be used for rebuilding [8]. Although allowing government funds to be used for private reconstruction represents a significant change in policy, this amount is not enough to rebuild a new house.

Instead, Japanese government support for post-disaster housing reconstruction continues to focus on the provision of disaster recovery public housing. As all public housing in Japan, rents for qualified residents are subsidized by the government based on residents’ income. Public housing includes multi-family apartment-style buildings as well as single family detached houses. In addition to systems supporting the reconstruction of houses or provision of in-kind public housing units, through the use of post-disaster relocation projects, the government provides and prepares new lots for residential reconstruction, including land clearing and preparation of roads and other site infrastructure.

3.3. Localized Recovery Housing in the Context of Contemporary Construction Trends
Although as the common Japanese building material through history wood had been used for temporary housing in the past, after the 1995 Hanshin Awaji Earthquake in Kobe most temporary housing was prefabricated metal construction. Since then, all of Japan’s 47 prefectures entered into agreements with the Japan Prefabricated Construction Suppliers and Manufacturers Association (abbreviated as pre-kyo in Japanese) which allows member companies to quickly provide temporary housing after a disaster [9].

Along with this shift to the use of prefabricated structures for temporary housing, the Japanese private housing market has also become increasingly dominated by mass-produced and pre-fabricated houses built by Japan’s massive “housemaker” corporations [10]; mirroring typical suburban housing development patterns, homeowners rebuilding post-disaster are also likely to choose a house from a housemaker. In contrast to this process of increasing reliance on mass-production and pre-fabrication for both temporary and permanent housing after disaster, localized disaster recovery housing promotes the use of local resources (materials and people). Within Japan’s post-disaster housing recovery process, localized housing recovery can therefore include: 1) wooden temporary housing provided by the government; 2) privately rebuilt houses; and 3) single family detached disaster recovery public housing built by the government. The following section introduces cases from these 3 types.

4. Cases of Localized Housing Recovery in Japan

4.1. The Birth of ‘Localized Housing Recovery’ after the 2004 Chuetsu Earthquake
On October 23, 2004, the Chuetsu Earthquake struck the rural, mountainous areas of Niigata Prefecture. With the goal of supporting as many people as possible to be able to return and rebuild in the heavily damaged Yamakoshi area, Nagaoka City created a committee to develop a “Uplands Localized Recovery House” (hereafter: Uplands House) that was required to be: 1) a “Yamakoshi-like” house; 2) able to co-exist well with snow; 3) have local circulation; 4) built for a low construction cost (under 10 million yen, or about $100,000 US); and 5) a house where people can live safely and comfortably for a long time[11]. Two model units of the Uplands Houses were built with 3 meter and 6 meter floor elevation, respectively, so residents rebuilding their own houses could see and experience these designs.

The creation of this localized model for housing recovery was the result of strong local government leadership and involvement of multiple actors—financers, local builders and designers in cooperation with Nagaoka City and housing developers—to build Yamakoshi’s Localized Recovery Housing, shown in Figure 1. Construction of the Uplands House used local materials and companies, which has an ecological benefit and minimizes construction costs. The houses were designed to be comfortable in the local climate, to use low energy and be easy to care for and survive long term exposure to the elements. Using a traditional modular plan, the rooms can be rearranged to respond to potential future changes in household size or lifestyle. The Uplands House design was also used for the construction of disaster recovery public housing in Yamakoshi. In the first 3 years after the earthquake, 19 Uplands Houses were built by residents and 36 as public housing [11].

4.2. Temporary and Permanent Localized Housing Recovery: the 2011 Great East Japan Earthquake
On March 11, 2011, the Great East Japan Earthquake (GEJE) caused a massive tsunami that devasted communities along the north east Tohoku coast. The GEJE was a wide-area, complex disaster, including earthquake, fires, tsunami, and the nuclear meltdown at the Fukushima Daiichi Nuclear Power Plant. With more than 500 square kilometres inundated by the tsunami, 20,000 people lost their lives and 129,000 houses were completely damaged [12]. 470,000 people evacuated in the few days after the tsunami, and as of August 2018 close to 60,000 people are still living in temporary housing [6]. As of August 2018, in Fukushima where evacuees face longer term displacement from radioactive contamination, more than 10,000 people are living in temporary housing within Fukushima and more than 33,000 continue to live in evacuation outside of the prefecture [6].

Although Fukushima Prefecture, responsible for contracting the construction of temporary housing, had existing agreements with the pre-fabricated housing association, providing the large needed
numbers of temporary housing exceeded their capacity. In Fukushima, where nuclear evacuees face long term displacement, the prefecture promoted the use of wooden temporary housing, issuing two public calls for the construction of wooden temporary housing in April of 2011, and again in July of the same year. The first call was for 4000 units, and the 2nd call was for 1000 (later increased to 2000) units. Promoting the use of local materials, the conditions required that applicants be from Fukushima prefecture, and for the 2nd call, the conditions also specified that the houses should be able to be dismantled and relocated. As a result, there were 6,000 wooden temporary housing units built in Fukushima Prefecture, as well as 10,000 prefabricated units.

4.2.1. Wooden Temporary Housing in Miharu Town, Fukushima Prefecture. Miharu Town, located in the inland part of Fukushima Prefecture and not affected by tsunami or nuclear accident, became the location for temporary housing for 770 evacuee households from Tomioka Town and Katsurao Village, areas close to the Fukushima Daiichi Nuclear Power Plant. Through coordination with the Japan Institute of Architects Tohoku branch, the Making Recovery Housing in Miharu Town Committee worked with five local builders to construct 100 units of wooden temporary housing in Miharu Town. Instead of wood, the foundation for these houses was poured concrete, and all construction timbers were square and standard length. In addition to reducing costs, standard-sized timbers don’t require a special order but can be easily purchased at local stores. These houses included various improved features compared to usual temporary housing such as: substantial insulation in the floors, walls, exterior; insulation and ventilation in the ceiling; double pane glass; and spaces between each unit which provide noise isolation.

4.2.2. Wooden Temporary Housing and Permanent Conversion in Aizu Wakamatsu Town, Fukushima Prefecture. Wooden temporary housing was also provided for nuclear evacuees in Aizu Wakamatsu Town, in the inland area of Fukushima Prefecture. Using the Japanese itakura method, in which walls are constructed by setting solid wooden boards within a slotted frame, there was a plan from the beginning to reuse and convert the temporary housing to permanent housing. In the actual conversion, about 66% of the materials were reused. Although this is an ecological approach because materials are reused, the total cost for adjustments and additional materials needed in the conversion process made the cost equivalent to new construction.

4.2.3. Localized Permanent Recovery Housing after the GEJE: Iwanuma City, Miyagi Prefecture. In
Miyagi Prefecture, the coastal area of Iwanuma City was devastated by the tsunami, and residents from coastal areas moved to a new residential area inland in a collective relocation project. This new residential area includes both lots for people rebuilding their own houses and disaster recovery public housing. With collaboration between local designers, architects, and builders, designs for localized

Figure 4: “Kuro no Ie” model house in Iwanuma housing recovery were created for Iwanuma by the Japanese Institute of Architects, using a traditional Japanese housing module, and materials from within Miyagi Prefecture. Two housing designs were created to demonstrate this approach for people choosing to rebuild, including the smaller “Kuro no Ie” (Black House, Figure 4) and “Shiro no Ie” (White House, Figure 5) based on the modularity of traditional wooden construction. However, there were no residents who actually chose to use this design.

As the standard building method in Japan, wood construction is not only familiar and versatile, but the modularity of traditional construction can also contribute to flexibility in housing recovery. The traditional module for housing construction is based on an area the size of 8 tatami mats (1 tatami mat is a rectangle slightly smaller than 1 meter by 2 meters). This smallest module of Japanese construction is a 2 by 2 square, where each side of the square is the length of 2 tatami mats. The smallest housing unit using this module is the square shape (4 × 4) plan, where each side of the square is the length of 4 tatami mats. This smallest size housing unit based on the traditional module was the basis for the Kuro no Ie, as shown in Figure 6 (left top, left bottom). As fewer people live in multi-generation households and with an aging society, the number of small families is growing. To reduce costs, simple, small-sized homes can be used as basic housing units, with lofts and a second floor or expanding to a 4 × 6 (4 tatami mats wide and 6 tatami mats long) plan as needed, such as the Shiro no Ie design, Figure 6 (top right, top bottom). In addition, by using modules, materials can be standardized and costs reduced. The Kuro no Ie design was also used for the construction of disaster recovery public housing in Iwanuma, shown in Figure 7. In this case, the localized disaster recovery housing units were also arranged in a configuration to create shared community space and interactions.

Figure 6. Plans showing the design of Kuro no Ie (1st floor, bottom left, loft top left), and Shiro no Ie (1st floor bottom right, loft top right) housing design based on a traditional Japanese module of wooden construction. The Kuro no Ie is composed of 4 square modules, with each module having the dimensions the length of 2 tatami mats on each side. The Shiro no Ie is composed of 6 of the
4.3. Totsukawa Village after the 2011 Kii Peninsula Flood

Totsukawa Village in Nara Prefecture suffered severe damage in the 2011 Kii Peninsula Flood, with 18 houses completely destroyed and 30 houses partially damaged. With many small settlements, in some areas entire villages were destroyed. Totsukawa Village’s abundant forest resources were used to build localized housing recovery, including 30 wooden temporary houses built with local materials and carpenters, and a model of “Totsukawa Localized Recovery Housing.” This design was also used for the construction of disaster recovery public housing. In Totsukawa Village, with steep mountainous area and few flatlands, finding land and building housing was difficult. With increasing depopulation, and the percentage of elderly reaching 42.5%, vacant lots and houses were noticeable in each settlement. Based on investigating settlements’ history, model houses to promote localized disaster recovery were built on empty land which had not experienced past disasters. These were built of wood according to the disaster recovery public housing specifications. Using localized housing to rebuild on infill sites (Figure 8) is a model for sustainability of depopulated regions and the creation of more compact cities, and is a new approach to address problems of large scale projects such as

Figure 8. Totsukawa Village after reconstruction.
collective relocation.

5. Discussion

5.1. Economic Benefit
The economic benefit of localized housing is not only minimized construction costs but also support for the economy (and recovery) of the affected region. By using local workers (local builders/local carpenters), the majority of money spend on construction will go into the local economy. Secondary expenses which accompany new housing construction, such as construction for electric and water and sewer infrastructure, moving costs, purchase of furniture, and appliances, and paying for housing loans, represent a significant economic impact. According to data from the Japanese government, based on average construction cost of 25 million yen/ house, these secondary costs add up to an addition 51.7 million yen/house [13].

5.2. Design Benefits of Involving Local Designers and Builders
Although Japan is a small country, there are significant climatic variations, and housing built without an understanding of the local area may result in unsuitable designs. For example, after the Great East Japan Earthquake, many prefabricated temporary housing units were built using standard designs, without consideration for the cold winters in the Tohoku area. As a result, additional construction was needed to add exterior insulation (in effect adding an additional external wall), as well as double pane windows. Local builders who have experience with housing construction in the region, will already be familiar with building for the local climate, as well as local housing lifestyles.

5.3. Potential for Reuse of Wooden Temporary Housing
With recent examples such as in Aizu, where wooden temporary housing was converted into permanent housing, there is a growing discussion about the potential for this kind of building and material reuse. While there are still remaining challenges to make this process more effective, the government is also seriously considering measures to make similar processes easier in the future.

5.4. Developments and Challenges for Implementation of Localized Recovery Housing
In the years since ‘localized housing recovery’ was first introduced after the 2004 Chuetsu Earthquake, a growing number of disaster recovery housing projects have incorporated localized aspects including: the use of local materials/ timber construction; local builders/carpenters; and designs that reflect the local regional culture. After the 2011 Great East Japan Earthquake, there was a significant increase in the share of wooden housing as part of the total number of newly-built temporary housing; this has continued after subsequent disasters. There have also been more concerted efforts to promote the potential of localized housing to residents who are rebuilding post-disaster, as well as to promote localized housing for single family detached disaster recovery public housing. However, there are also challenges to carry out localized disaster recovery housing on a large scale. Key factors for successful implementation include strong leadership supporting of the idea of localized housing recovery from the beginning, timing, careful coordination of multiple stakeholders, and knowledge from those who have past experience with similar projects.

6. Conclusion
Drawing on traditional wood construction techniques, designs, and materials, localized housing recovery in Japan represents a way to not only support the disaster-affected area, but also to quickly provide high quality and comfortable housing to disaster survivors, using familiar materials. Houses designed and built by local builders will be more suitable for the local conditions than houses designed for a different climate/location. Moreover, the economic benefit from using localized housing is significant not only for local carpenters, but for the region’s economic recovery and long term sustainability. As ideas of localized housing recovery have advanced both in terms of the use of local human resources and local building materials, the implementation of localized housing has also advanced to be incorporated within the local community, as in the case of Totsukawa Village. The use
of local resources is widely supported within the international disaster recovery community of experts, and Japan’s localized housing recovery serves as a useful detailed example of the application of this approach. Although the post-disaster housing recovery context in Japan includes some specific policies regarding provision of temporary and permanent housing, lessons about the coordination of local resources and disaster recovery policies are relevant to other countries, especially where wooden construction is common.

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