

CHAPTER 2

THE RELATIONSHIP BETWEEN COMMUNITY SUPPORT AND RESIDENT BEHAVIOR AFTER THE TOHOKU PACIFIC EARTHQUAKE: THE CASE OF HITACHI CITY IN IBARAKI PREFECTURE

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ABSTRACT

Drawing on a case study in Hitachi City, Ibaraki prefecture, this chapter aims to analyze the relationship between community support and the behavior of residents after the Tohoku Pacific Earthquake in the regions affected by the disaster. The chapter will examine residents' behavior and the community's roles by way of the following process: (1) We will

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review Japan's natural disaster prevention regimes; (2) we will examine the result of a field survey conducted in Hitachi City detailing the city's natural disaster prevention procedures and the operation of some neighborhood evacuation sites; (3) the behavior of residents following the earthquake is analyzed. In this part, questionnaires were sent to 2000 households, of which 492 (24.6%) were collected and used for this analysis. The earthquake and tsunami destroyed lifelines such as water supply for several days in the city. According to the city, a total of 65 buildings were judged to be in dangerous condition, 251 as requiring care, and 478 were only partially damaged. The most serious damage was found mainly in the city's coastal areas, where a total of 85 houses were entirely or partly damaged, and 483 houses were flooded above the floorboards by the tsunami. On March 11, a total of 69 evacuation sites opened, and 13,607 residents rushed into them. After the disaster, residents initially tried to go back to their homes. Depending on the damage done, they either stayed there or moved to a relative's or friend's house, or to a neighborhood evacuation site. Due to the failure of the lifelines, transportation systems, and the damage caused by the disaster, most residents had to stay within an area more limited than usual, around which they could walk or ride by bicycle. Residents had only the human and physical resources of their neighborhoods. Therefore, the characteristics of their local communities affected how residents behaved during and after the earthquake.

Keywords: Local response; behavior; evacuation sites; the Tohoku Pacific Earthquake; Hitachi City

INTRODUCTION

Background of the Study

The Tohoku Pacific Earthquake and Tsunami of 2011 caused incalculable damage in Eastern Japan. Both the Japanese government and scholars in many academic fields have been working for a rapid recovery from this disaster. Big earthquakes affect local economies and communities, thus disrupting the daily lives of residents. Urban reconstruction can, however, revive those damaged, and many actors, including the national government,

local authorities, non-profit organizations (NPOs), and local residents, have been evaluating restoration plans (Edgington, 2010).

In Japan, local communities play particularly important roles during and after disasters. Local governments designate and operate evacuation sites, usually elementary and junior high schools, and residents are trained in evacuation drills to move to them. Local communities and school personnel actively engage in their practical functioning and also assist in the reconstruction of neighborhoods (Ishii, Yamazaki, Namai, Uchida, & Okazawa, 1996). During and after disasters, most residents have to stay in smaller areas than usual and travel on bicycles rather than in automobiles, since the physical distribution of products, including gasoline, has completely stopped and roads are damaged. At the same time, public services and transportation are severed. Thus, the activity fields of residents are confined to walking distances, a limitation that stimulates the formation of communal groups (Fujioka, 1996). Heeren (1999) mentions that disaster victims build bonds in their neighborhoods because they simultaneously share the same strong emotions. A disaster can be an opportunity for residents to discover their neighborhoods. Despite this seminal fact, the relationship between community support systems and the behaviors of residents after an earthquake has not been sufficiently examined.

Studies of the 1995 Great Hanshin-Awaji Earthquake in the Kansai region of Japan have shown that the degree of damage was influenced by the area's residential structure (Kagawa, 1995; also see Table A.1 in the appendix). Ishii et al. (1996) demonstrate that earthquake victims tend to be the weak, such as elderly females, and that an area's residential characteristics, such as the types of housing and building materials, determine the levels of damage (Fukutome, 1999). In the Japanese housing system, those with private means dwell in disaster-resistant houses on hillside, while those without them tend to live in social housing in disaster-prone areas (Hirayama, 2000). Housing structures are closely related to social structures and community characteristics; thus, opportunities and damages are unevenly distributed in disaster-affected regions.

To examine the successful urban reconstruction that took place after the Tohoku Pacific Earthquake and Tsunami, we address the following questions in this chapter: (1) What was the actual damage caused by the earthquake? (2) How did the community proceed after the earthquake? (3) Did community support systems affect the behavior of residents, and if they did, how did they affect it?

The problem of sketchy information was pointed out after the Great Hanshin-Awaji Earthquake. Although the disaster spread throughout the

Kansai region, information about damage was limited to the core areas (Kanasaka, 1995). However, detailed facts and field surveys of the surrounding regions were required for reconstruction planning and damage containment, since destruction of electricity, water services, and core transportation systems was widespread, indicating that more complete disaster damage prevention plans were necessary (Kagawa, 1995).

Methodology of the Study

This study analyzes the relationship between community support systems and the behavioral responses of residents after the Tohoku Pacific Earthquake in the zones surrounding the disaster. Our study area is Hitachi City in the Ibaraki prefecture, where the earthquake and tsunami affected the daily lives of residents.

To achieve our objective, we adopted a perceptual and behavioral approach to geography. It focuses on human perceptions of the environment and the decision-making processes that affect behavioral responses.¹ This method opposes the “quantification revolution” in academic research. Its main interests are human behavior, including the perception of natural disasters, consumption patterns, residential choices, the evaluation of residential environments, and the image perceptions of places (Gold, 1980; Okamoto, 1998). The perceptual-behavioral approach contributes to the understanding of human actions in natural disasters (Ganzawa, Kito, & Sadakata, 1995; Okamoto, 1998; Wakabayashi, 2009).

In addition, perceptual-behavioral approaches permit a deep understanding of disadvantaged social groups, such as elderly or handicapped persons, children, women with infants, and foreigners (Okamoto, 1998). As many studies have mentioned, such groups are more vulnerable to natural disasters (Bolin & Stanford, 1998; Ishii et al., 1996; Wisner, 1998), but their needs are rarely reflected in services or disaster-mitigation policies (Takeda, Tamura, & Tatsuiki, 2003). We deal with the behavioral responses of residents after a disaster, placing an emphasis on community support systems that strongly influence their reactions. Resident perceptions of their neighborhoods or residential environments are also discussed.

This chapter examines resident behavioral responses and community roles in the following process. First, we review Japan’s natural disaster prevention regime, focusing on school education (including evacuation drills), community preparation for emergencies, and local government disaster responses. Second, we examine the results of a field survey conducted in

Hitachi City that details that community's natural disaster prevention procedures and the operation of some neighborhood evacuation sites. Third, the behavioral responses of residents following the earthquake are analyzed through a mail survey and personal interviews. Questionnaires were sent to 2000 households, of which 492 (24.6%) responded. The questionnaires collected information on (1) the extent of damage to residences, (2) the types of housing (including building materials and construction periods), and (3) resident behavioral responses after the earthquake.

JAPAN'S NATURAL DISASTER PREVENTION REGIME

The National and Local Governmental Regimes for Disaster Prevention

Japan is located on the Circum-Pacific Seismic Belt, which is more popularly called the "Ring of Fire"; geographical, topographical, and meteorological conditions make it one of the most disaster-prone countries in the world. In addition, the nation's population and economic activities are concentrated in highly urbanized areas, which are intensely and intricately exploited and where there are very few open spaces (Mather, Karan, & Iijima, 1998). Japanese disaster management systems have been developed and modified after several large-scale natural catastrophes. In the 1940s, several natural disasters such as Typhoon Makurazaki (1945), the Nankai Earthquake (1946), Typhoon Catherine (1947), and the Fukui Earthquake (1948) caused serious damage (see Table A.1 in the appendix). To permit the recovery from disasters and to provide aid to victims, the Japanese government enacted the Disaster Relief Act (in 1947, after the Nankai Earthquake), the Flood Control Act (in 1949, after the two great typhoons), and the Building Standard Law (in 1950, after the Fukui Earthquake). The major Japanese disaster management acts, plans, and systems were established following Typhoon Ise-wan (1959), the Great Hanshin-Awaji Earthquake (1995), and the Niigata-Chuetsu Earthquake (2004) (Cabinet Office, Government of Japan, 2011; also see Table A.1 in the appendix).

In the Japanese reconstruction management system, the national government has taken responsibility for the reclamation of urban infrastructures and transportation systems and the removal of debris. This charge was established in the period of rapid economic growth, when national or local governments undertook much urban infrastructure construction and development in order to attain the levels of Western cities. Other objectives such

as the recovery of damaged communities or the revitalization of local economies were assumed by individuals, NPOs, or private enterprises (Edgington, 2010). Generally, the Japanese people have expected little governmental support, even during or after great disasters (Ozerdem & Jacoby, 2006). A lack of communication exists between national or local governments and citizens in Japan; in fact, it is rare for government officials to take the views of local people into account (Pekkanen, 2006; Schwartz & Pharr, 2003). For disaster-prevention, Japanese planners have developed disaster-proof construction techniques, such as base-isolating buildings or embankments. In contrast, insurance systems for disasters or support systems for victims have been weak in Japan (Murakami, 1996).

Japanese reconstruction management has been characterized by top-down or hierarchical systems (Edgington, 2010). For example, the early warning system for emergencies starts with national institutions (Japan Meteorological Agency, the national government ministries, and the agencies related to disaster management), which pass orders to local governments. These local governments then convey disaster information to their citizens (Cabinet Office, Government of Japan, 2011). When disasters occur, information or orders thus move along this top-down system. For example, during the Great Hanshin-Awaji Earthquake in 1995, local governments officially took part in the management of evacuation sites (obtaining information or support from the national government and distributing it to local sites), but substantial parts of the recovery operation were carried out by school personnel or local communities (Ishii et al., 1996).

Although reconstruction processes are led by the Japanese government or local authorities, the voices of residents became increasingly important after the 1995 Kobe earthquake, which utilized *machizukuri* methods, that is, those that relied on local residents and specialists, such as architects, to create neighborhood rebuilding plans, in addition to traditional top-down methods, such as land readjustment and urban reconstruction (Edgington, 2010).

Evacuation Drills and Community Preparation for Natural Disasters in Japan

Under the Disaster Countermeasures Basic Act, which was adopted in 1961 after Typhoon Ise-Wan, obligatory disaster reduction drills were established in Japan. After the Great Kanto Earthquake of 1923, the September 1 was

designated as “Disaster Reduction Day”; on it each year, drills to mitigate natural catastrophes are conducted by governmental institutions, schools, other educational facilities, private enterprises, and local communities (Cabinet Office, Government of Japan, 2011). Through these drills, the Japanese are trained to engage in proper actions in emergencies. Edgington (2010, p. 28) holds, however, that “these exercises may be viewed as symbolic – as ‘collective exorcism’ – rather than as genuine efforts to train communities in disaster preparation.” Indeed, it is unclear if such drills involve sincere participation, a point that will be taken up later in this chapter.

According to Kunugiza and Matsui (2005), when a tsunami hits a residential area just after an earthquake, as a tsunami reached three minutes after the earthquake to the southwest off Hokkaido Earthquake in 1993, top-down information systems cannot work efficiently; it takes at least four minutes until a tsunami warning is broadcast by television or radio. These scholars, therefore, insist that disaster reduction education must be designed to alter human perceptions of risk and to aid in correct decision making. Most university students or residents, however, did not make the “right” choices in emergencies because their discernments were affected by media messages indicating that “helping people die should be praised more than quick survival evacuations” (Kunugiza & Matsui, 2005). In all, 201 people died and 28 disappeared in the 1993 earthquake and tsunami southwest off Hokkaido (Ganzawa et al., 1995). With this tragic background in mind, it is important to realize that local communities, school personnel, and individuals are capable of making informed survival decisions. Evacuation drills in communities, schools, and offices are expected to better emergency decision making.

EARTHQUAKE DAMAGE AND DISASTER PREVENTION IN HITACHI CITY

Geography of Hitachi City

In this section, we examine the disaster-prevention plans of Hitachi City and its reaction to the 2011 earthquake and tsunami. Hitachi City, which is located in northern part of Ibaraki prefecture, has a population of about 200,000. It developed as a mining and manufacturing town at the turn of the last century, when a large part of its land area was in the past covered

by copper and pyrites mines. Later, it was widely known as the company town of the Hitachi Ltd, an engineering and electric company. Although the Hitachi Ltd moved its head office to Tokyo, it maintains branch offices and many factories in Hitachi City, about 40% of whose residents work for the company; others work in the fishing, tourism, and agricultural industries, or in manufacturing.

The topography of Hitachi City (Fig. 1) reveals its disaster-prone characteristics. Most of its surface is mountainous; its people live on a narrow, rather low coastal plain. The distance between the coastline and mountainous areas is usually less than five kilometers. In a tsunami occurs, a large part of the residential areas is easily inundated, and limited evacuation roads can cause panic. The topography causes chronic traffic congestion; there is one Joban highway route and three national roads, the south to north Route 6 and Route 245, and the west to east Route 293. In addition, the JR Joban line runs south to north and connects the city to Tokyo and the Tohoku region. Most large housing estates (more than 100 housing units) were built on hillsides from the 1960s onwards as residences for mining workers and Hitachi staff (Fig. 2).

Hitachi's Condition After the Disaster

According to the classic model of Kates and Pijawka (1977), the reconstruction processes following a natural disaster is composed of four phases: the emergency, restoration, replacement/reconstruction, and developmental/reconstruction periods. Hitachi City, which was damaged by the recent earthquake and tsunami, is now in the final period of this model. Although coastal areas were seriously devastated by the tsunami, most of the hotels located in them reopened at the end of September 2011, just six months after the calamity. Fishing and related industries in Hitachi City have not, however, completely recovered, since the levels of radioactive substances in marine products remained higher than usual in 2012. The fishery association of the Ibaraki prefecture has established standards for these substances that are stricter than the national ones, hoping to avoid the harms of rumor that its products contain dangerously elevation concentrations of radioactivity (*fuhyo-higai*). Gradually, fishery industry starts their business as the radioactivity levels decline.² Thus, the people and industries of Hitachi City have suffered from both the direct and immediate damage of the earthquake and tsunami and from the long-term effects of the nuclear accident that was triggered by them.

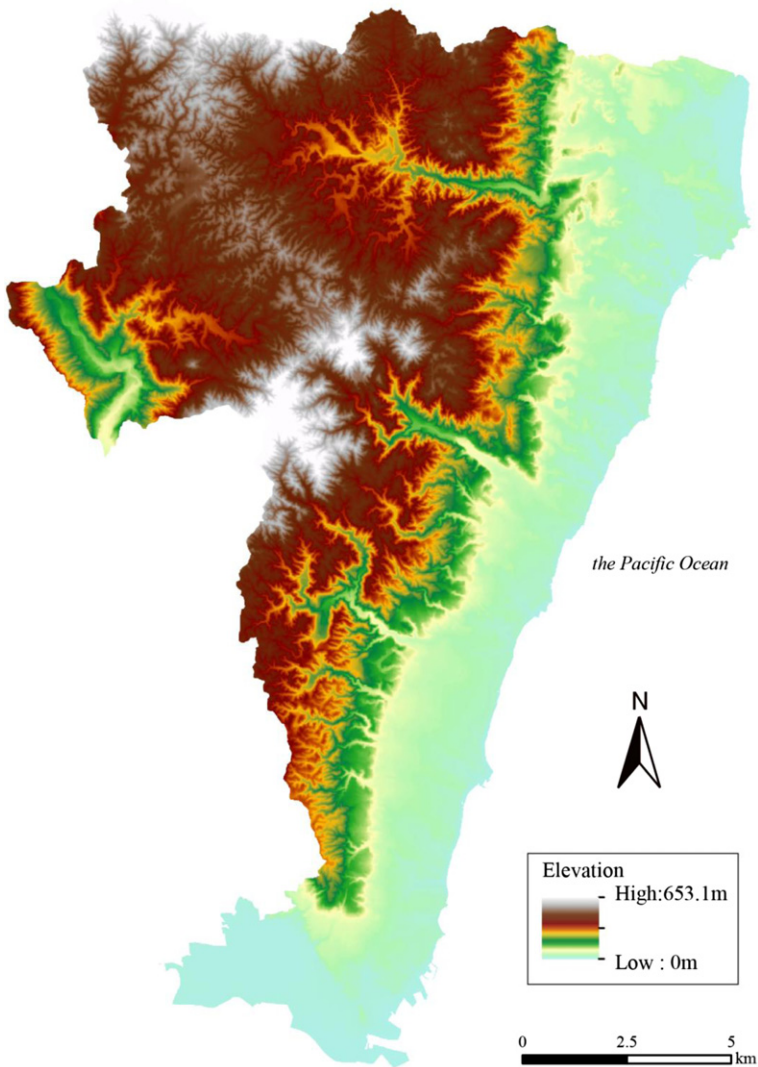


Fig. 1. Topography of Hitachi City.

Local communities, urban structures, and socio-economic or cultural conditions are regarded as important factors in determining the recovery and reconstruction processes (Alexander, 1993; Massard-Guilbaud, 2002; Mileti, 1999) following natural calamities. In the following sections, we

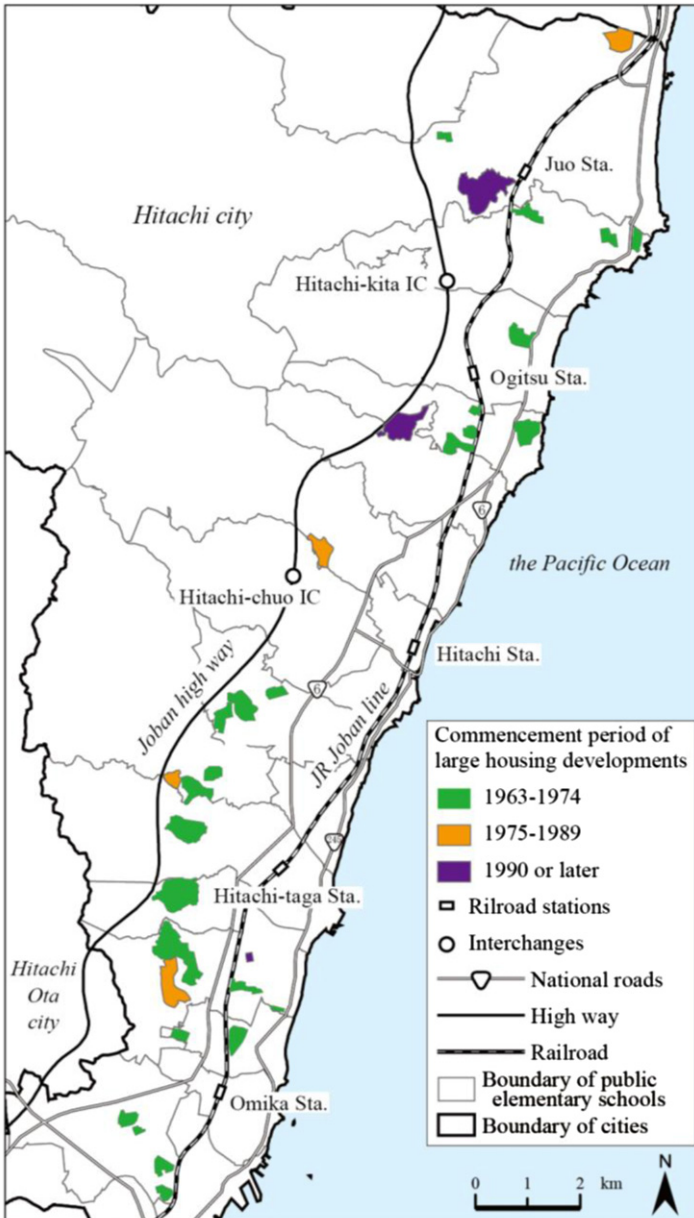


Fig. 2. Distribution of Large Housing Estates in Hitachi City (1963–2006).
 Note: Adapted from Hashimoto et al. (2012). Source: Hitachi City Urban Planning Materials (2006).

treat Hitachi as a case study, focusing on the resilience of the city; we explore, in particular, its prevention plan for natural disaster damage, the material and human harms caused by the earthquake and tsunami of 2011, and community responses to them.

Prevention of Disaster Damage

Hitachi City has paid great attention to the preclusion of nuclear emergencies since the Tokai-mura JCO Nuclear Accident in 1999, which follows the Fukushima Daiichi nuclear disaster of 2011 in gravity.³ Adjacent to Tokai-mura in the south, some of its residents, who are employed in these nuclear facilities, were affected by the JCO incident; as a result, the residents of Hitachi City have greater knowledge of nuclear facilities than the inhabitants of other Japanese areas.

Hitachi City's Act on the Prevention of Emergencies provides for four nuclear emergency advisors in a disaster-countermeasures office. The municipality has been distributing disaster radios to residents since 2000, although 26,000 households have not yet received them (May 2011). It also built broadcasting towers to communicate important information to residents during nuclear emergencies. Hazard maps for natural disasters, including tsunamis, have been published; evacuation sites are designated on them, and evacuation drills are conducted at least once a year by educational institutions, local communities, and companies.

Damage in Hitachi City

The earthquake destroyed major public infrastructures and services, such as the water supply, sewage, electricity, and gas for several days in the city; the water supply was not restored until the end of March in some areas. In a large part of the municipality, houses were damaged only slightly, and roofs and walls only partially. According to the city's report from May 22, a total of 65 buildings were assessed as dangerous, 251 judged as requiring care, and 478 listed as partially damaged. The most serious destruction occurred in the city's coastal areas, where a total of 85 houses were entirely or partly damaged and 483 others were flooded above their floorboards by the tsunami. The Japanese Reconstruction Agency reported that there were 13 people dead by the Tohoku Pacific Earthquake and Tsunami in Hitachi City (March 31, 2013).⁴

On March 11, a total of 69 evacuation sites opened in which 13,607 residents found shelter (Figs. 3 and 4). In addition to the designated evacuation sites, high schools and local community centers were hastily used as shelters. Main roads and the JR Joban line were rendered impassible in several places by the earthquake and subsequent tsunami; people were stranded and rushed into the evacuation sites in the central area of the city, two of which officially accepted evacuees from the Fukushima prefecture (one remained open until March 26 and other until April 11). Local community residents assisted officials at each site, as detailed in the next section.

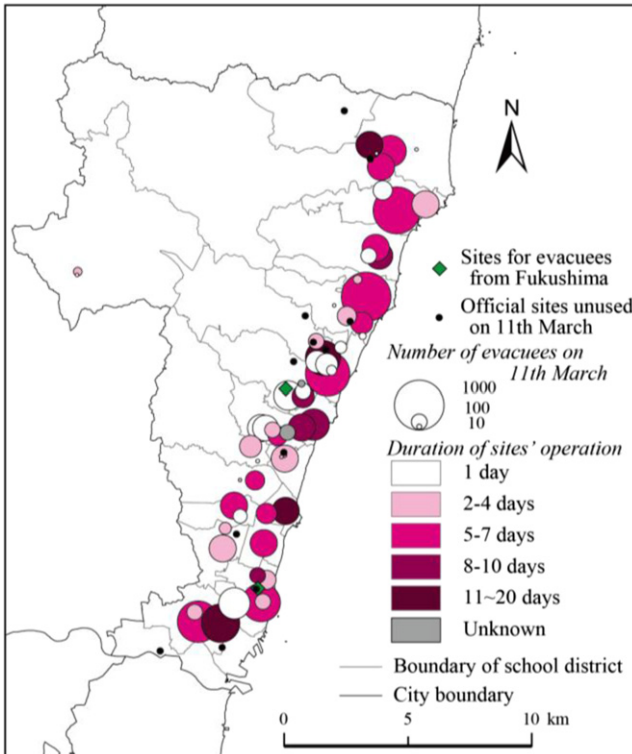


Fig. 3. Location of Evacuation Sites and Their Operation After the Tohoku Pacific Earthquake in Hitachi City (2011). Source: Data Provided by Hitachi City Administration.

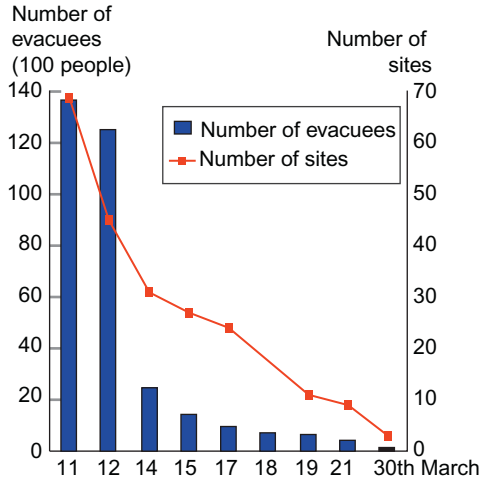


Fig. 4. The Number of Evacuation Sites and Their Evacuees After the Tohoku Pacific Earthquake (March 11–30, 2011) in Hitachi City. *Source:* Data Provided by Hitachi City Administration.

RESPONSE OF LOCAL COMMUNITIES: OPERATION OF EVACUATION SITES

An Old Housing Estate

First, we will describe the case of a housing estate on a hillside area of the city. Developed in 1973, it consists mainly of detached owner-occupied houses. Most of the residents, initially married couples with children, moved into the area when sales began. Over time, children left parental homes and the estate’s population fell by one-third; 22.5% of its inhabitants are elderly (January 2010). In recent decades, rental apartments, preferred by young families, and public housing went up in this area. This newer construction has mitigated the rapid aging of the overall community.⁵ Since most of the residents shared similar household characteristics and lived in the estate for more than 30 years, community activities were quite established and functional. From 1984 to 1989, the estate was selected to be a model community by the Ministry of Internal Affairs and Communication for community promotions. Later, it won official commendations.

Housing damage was not serious in this area, but the earthquake impaired its public and private services. Residents who lacked food, water, heating, or non-electrical cooking facilities moved into the area's evacuation sites. In addition to the designated site (a gym in an elementary school), a community center was hastily employed. On March 11, 390 residents moved into the school and 105 into the community center (Fig. 5). On March 15, when the area's electricity was restored, the numbers fell to 86 and 30, respectively. Finally, both sites were closed on March 19.

Table 1 indicates the assistance offered by local communities in evacuation site operation. About 25 minutes after the earthquake, community members started patrolling their neighborhood. Within 45 minutes, they set up a local disaster headquarter in the community center. It was soon moved to the city's designated evacuation site. In the evacuation sites, the local community provided (1) food to both evacuees and residents who could not leave, including the elderly and handicapped; (2) medical examinations and exercise instructions, assisted by the area's volunteer medical staff; (3) drinking and waste water; and (4) information on the earthquake.

Thanks to an evacuation drill in November 2010, members of the local community easily assumed their roles during the emergency. Along with the employees of local companies and staffs of medical facilities, they had been participating in annual evacuation drills for years. The community's participation resulted in a well-organized and successful operation.

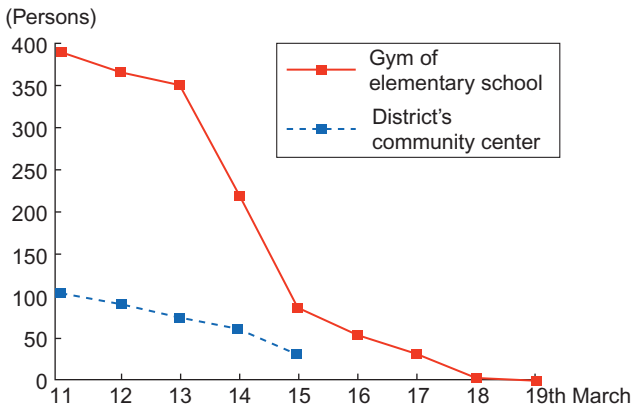


Fig. 5. The Number of Evacuees in a Housing-Estate Neighborhood in Hitachi City (March 11–19, 2011). *Source:* Data Provided by the District's Community Center.

Table 1. Community Support After the Tohoku Pacific Earthquake in a Housing Estate of Hitachi City (March 2011).

Date	Time	Activities by Community Members and Other Activities
11	14:46	Occurrence of the earthquake
	15:10	A patrol by community members (taking care of injured residents, etc.)
	15:30	Set up "local disaster headquarter" in the district's community center
		Meeting of community members; collecting and distributing disaster information
		Visiting residents who ask for support (193 persons); moving them to the evacuation site (Community members in charge of welfare ⇒ Welfare officers)
16:00	Establishment of evacuation sites (community members and city staff)	
	16:55	105 evacuees for elementary school, 105 for small community center
15	18:50	Closure of the evacuation site in local community center
		A large part of the district's electricity restored
18	14:00	Main evacuation site was moved to the district's community center
19	16:00	Closure of the evacuation site in the district's community center
21	9:35	Water supply restored in most houses of the district

Source: Data provided by the district's community members.

Electricity service was restored on March 15, and gas, water supply, and sewage services restarted within 10 days.

A Coastal Settlement

The case described here is that of a coastal settlement affected by the tsunami (Fig. 6). At the time of the disaster, most of its residents had lived there for generations and had close connections with each other. They tended to depend on their private networks rather than on their local community. Many worked as fishermen or ran coastal inns. However, hillside areas in the same neighborhood show completely different features; most of their inhabitants, who worked for Hitachi Ltd or its related businesses, had been in residence for less than 30 years. This diverse resident mix resulted into unsuccessful operations at the site.

On Hitachi City's tsunami-hazard map, this coastal settlement and its hillside neighborhoods shared the same designated evacuation sites which were built on a hill. The post-earthquake condition of these sites was, however, inadequate; some of their windows had been broken, allowing cold

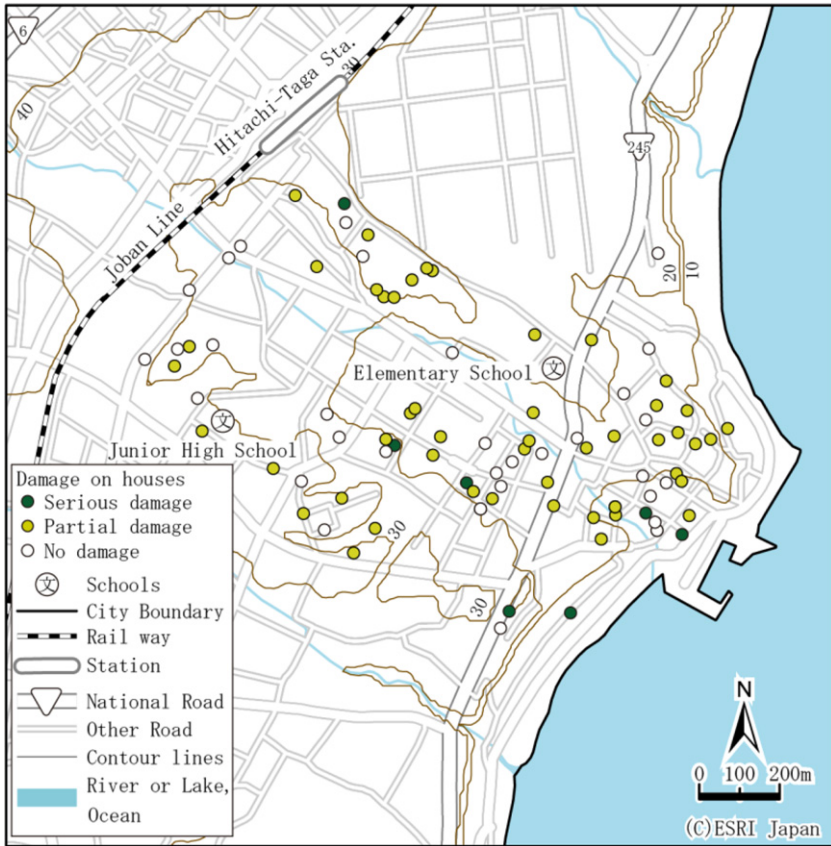


Fig. 6. Damages on Houses After the Tohoku Pacific Earthquake in a Coastal Settlement of Hitachi City (2011). *Source:* Authors' Questionnaire Survey, and Fundamental Geospatial Data.

wind to enter, and they lacked blankets and heat. Although the hillside community tried to support the sites' operation, they found the provisioning of food and water arduous (Table 2). On March 11, an inn with a stockpile of food offered rice to the local community, and volunteers from the hillside community helped distribute them to evacuees. Although members of the local community assisted in these operations, their roles were minimal. In this neighborhood, electricity supply was restored on March 16, and gas, water supply, and sewage began on March 22. The renewal of drinking water was the most difficult task for residents.

Table 2. Community Support After the Tohoku Pacific Earthquake in a Coastal Settlement of Hitachi City (March 2011).

Date	Activities by Community Members and Other Activities
11–20	Volunteer activity by community members and residents
11	Distribution of food (materials from nearby inn and residents)
12	Distribution of food (volunteers from residents) and water
13	Distribution of water for toilets; use of power generators for lighting; visits to elderly people by the district's welfare officer
18	Volunteer work for the victims of tsunami in the district

Source: Data provided by the district's community members.

A large number of coastal residents who suffered serious harm from the tsunami depended on their relatives or friends rather than on the local community. In the coastal settlement, where people had strong economic and family ties, residents preferred staying at home and helping each other rather than moving to evacuation sites. Although they had earlier conducted disaster reduction drills for fires (in which all community members participated) and tsunamis (which were restricted to coastal residents), the evacuation sites did not succeed.

As Alexander (1993) points out, original area conditions or problems can be magnified after disasters. In Hitachi, if a local community was well organized and had its own disaster-response systems before the calamity, it successfully organized evacuation sites and managed the distribution of food, water, and information to residents. In comparison, a community divided by conflicts, some invisible, was far less effective in its supervision of evacuation sites and its reconstruction process. We confirmed the imperceptible split between fishery residents, who preferred traditional, familial, and friendship support bonds, and white-collar new residents, who joined community activities.

BEHAVIORAL RESPONSES OF RESIDENTS AFTER THE EARTHQUAKE

Patterns of Resident Behavioral Responses

The patterns of the behavioral responses of household heads were classified into six categories, which appear in Table 3.

Table 3. Patterns of Household Head Responses After the Tohoku Pacific Earthquake in Hitachi City (2011).

Types of Behavioral Responses	Number	Percentage
(1) Stayed at home	335	68.1
(2) Moved to evacuation sites	4	0.8
(3) Stayed at friends' or relatives' houses	24	4.9
(4) Went to work	26	5.3
(5) Were stranded	66	13.4
(6) A mixture of several types, and others	16	3.3
(7) Unknown	21	4.3
Total	492	100

Source: Authors' questionnaire survey.

- **Stayed at home:** This category refers to those that went home on March 11 and stayed a long time after the earthquake. A total of 335 household heads (68.1%) followed this pattern. They tended to work either in Hitachi City or in neighboring towns and did not use public transportation to travel to their offices. They remained at home for about one week or longer, exiting only to find well water and open grocery stores or to meet friends or relatives.
- **Moved to evacuation sites:** Those that moved to evacuation sites after the earthquake fell into this category. Only four household heads (0.8%) moved to evacuation sites. We should mention that spouses, usually females, were more likely to use evacuation sites after the earthquake.
- **Stayed at friends' or relatives' houses:** In all, 24 respondents (4.9%) stayed at friends' or relatives' houses because their own homes were damaged by the earthquake or tsunami.
- **Went to work:** This category concerns 26 respondents (5.3%) who went to work soon after the earthquake. Most of them lived in undamaged houses in the new housing estate built in a hillside area. Using the restored public transportation systems or their own cars or bikes, they quickly resumed their work.
- **Were stranded:** This group includes 66 household heads (13.4%) who were stranded for several days after the failure of transportation systems. They tended to work in Tokyo or were on visits; thus, they could not return home on March 11.
- **Mixture of several types:** This category is a mixture of the other five types. It comprises 16 answers (3.3%). A total of 21 households (4.3%) did not answer this question.

Effects of Community Support on the Behavior of Residents

In addition to the damage caused by the earthquake and tsunami, the characteristics of the local communities determined evacuation sites operations, thus affecting resident's behavioral responses. This observation is demonstrated in the following three cases.

A Case of a Young Family in a Housing Estate

In the old housing estate, the local community took a leading and successful role in operating the evacuation sites. This helped young residents who had never participated in such activities understand the importance of local community participation. Some young residents moved to the evacuation sites after the earthquake and had opportunities to join in volunteering. In the authors' interviews, these residents mentioned that they had gradually developed an attachment to the local community; this development could help in the building of a sustainable communal spirit. A model of a young family's behavior in this neighborhood in the aftermath of the disaster is depicted in Fig. 7.

The family members are the household head, his spouse, and their little girl; they had never joined in community activities before the earthquake. Just after the earthquake, the wife and her child moved to the evacuation site, and they stayed there until March 23. As their little girl trembled with fear whenever small shakes caused creaks in its house, the family had later moved into the house of the child's grandparents.

In the evacuation site, the wife joined in volunteer work, such as preparing food for evacuees; community members led healthy evacuees in such activities in order to supplement the food or water supplies distributed by the local government. In addition, young mothers with small children helped each other so that they could feel comfortable in the evacuation site. These experiences caused a major change to the wife's mind, who now says, "I want to raise my child in this neighborhood. She will go to an elementary school here. Now, I wish to join community activities much more than before. The local community contributes to our healthy and comfortable daily lives."

A Case of a Family of a Coastal Settlement

In the coastal settlement, by contrast, residents tended to depend on their own personal networks. Many residents settled there generations ago, and their relatives and friends lived nearby. Although they could have used the

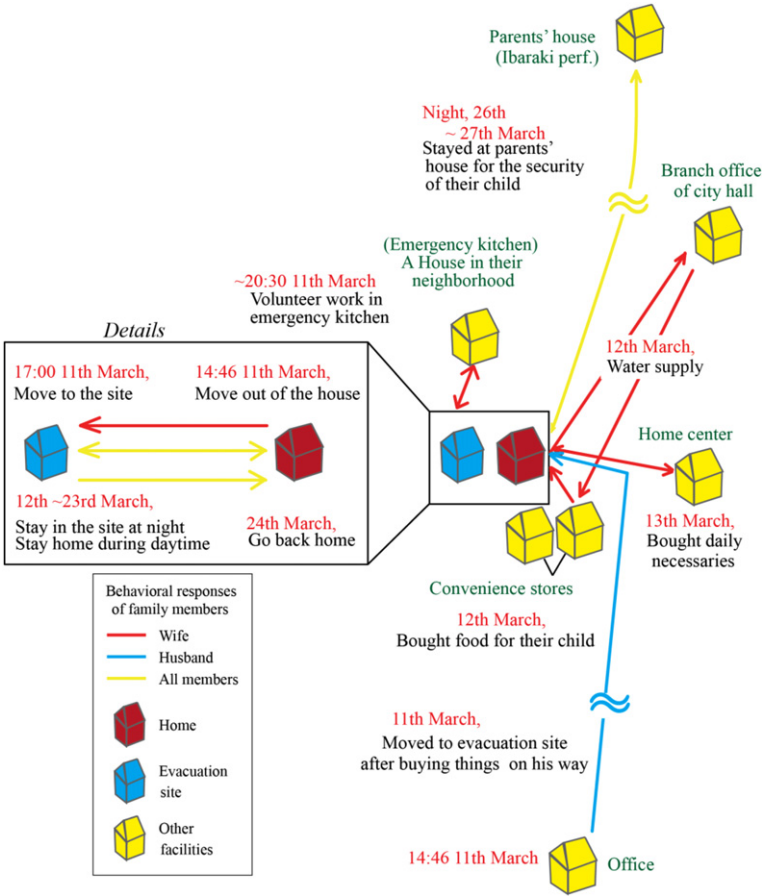


Fig. 7. A Case of a Young Family in Hitachi City After the Tohoku Pacific Earthquake. Source: Authors' Interview Survey.

evacuation sites, they preferred relying on their connections. Fig. 8 depicts their behavior.

The family's house completely collapsed in the tsunami; its members, who run a coastal inn, are the household head (a fisherman), his mother, and his grandmother. After the earthquake, his grandmother moved to a relative's house in another area.

After the tsunami struck, the mother immediately moved to the evacuation site only to find the place in a chaotic state. The household head tried

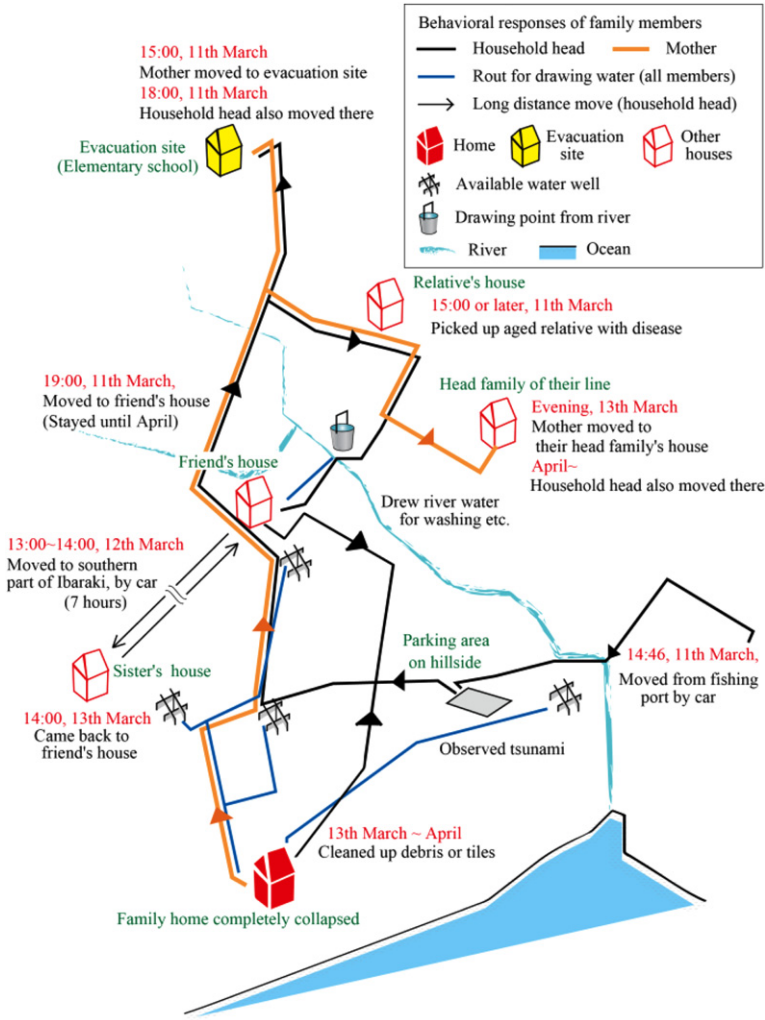


Fig. 8. A Case of a Tsunami-Affected Family in Hitachi City After the Tohoku Pacific Earthquake. Source: Authors' Interview Survey.

to return home, but he noticed that the tsunami was coming; he observed it from a parking area on a nearby hillside and saw his house collapse. At around 6 o'clock in the evening, family members met each other at the site and soon they moved to a nearby relative's house. They reached the head-

family house (*honke*) in the evening; the household head's mother stayed there for about one month. It was natural for them to ask for the support for their head family.⁶ The household head moved to his friend's house; he tried to fix his house during the daytime and went back to his friend's house at night for about 20 days. On March 12, the household head drove to the southern part of Ibaraki prefecture in order to take his grandmother there for safety. He says, "Indeed, I lost almost everything by the tsunami, but one most important thing, bond, remained."

The family could have stayed in the evacuation site, but they did not choose this option for several reasons: (1) The condition of the site was not perfect; some windows were broken and blankets, which should have been stockpiled, were not kept in the designated storehouse of their district. (2) The operation of the site was not successful, since the local community, whose members were mainly newcomers, did not take initiatives in operating it. (3) The family had lived in the neighborhoods for generations and had very strong local familial and friendship bonds. (4) Based on family ties, the family had its own channels of communication with neighbors, while newcomers were excluded from this system.

For the reasons mentioned above, the residents of coastal settlements tended to move out of the evacuation site. This finding suggests that not only its condition but also the characteristics of the local community affected the success of disaster operations.

A Case of a Stranded Family

Finally, we discuss the case of a family stranded after the earthquake (Fig. 9). It took four days until all family members returned home. When the earthquake occurred, the household head was in his Tokyo office and had to stay there for about four days. As the railroad service to the northern Kanto and Tohoku regions completely stopped for several days, he could not get home. Four days later when the highway was opened, he traveled home on a bus.

The wife and the daughter were also left stranded; they moved to several evacuation sites on their way home from the daughter's school. At the time of the earthquake, the wife was on her way to pick up her daughter at a high school in a neighboring city. Late at night of March 11, the wife could find the location of her daughter and went home.

As telephone services did not work for several hours, it was difficult for most people to know if their family members were safe. Most Japanese have been trained to go to a nearby evacuation site, usually public schools. This training makes it easier for people to find where their family members are in

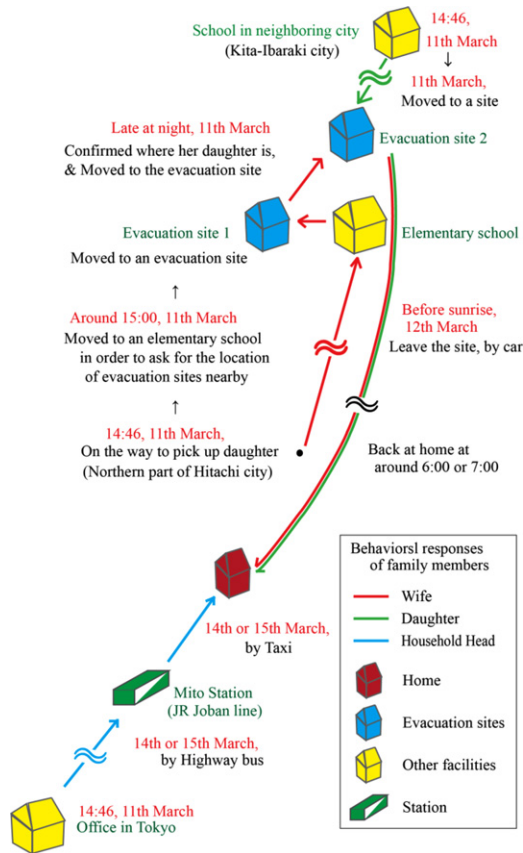


Fig. 9. A Case of a Stranded Family in Hitachi City After the Tohoku Pacific Earthquake. Source: Authors' Interview Survey.

such emergencies. In contrast to Edgington (2010), who notes that Japanese evacuation drills are more symbolic than practical, we demonstrate that the drills are fundamental in personal decision making during emergencies.

Changes of Neighborhood Perceptions Before and After the Disaster

Perception on Residential Environment

Fig. 10 indicates the changes of resident perceptions of neighborhood environments before and after the disaster. In most cases, residents

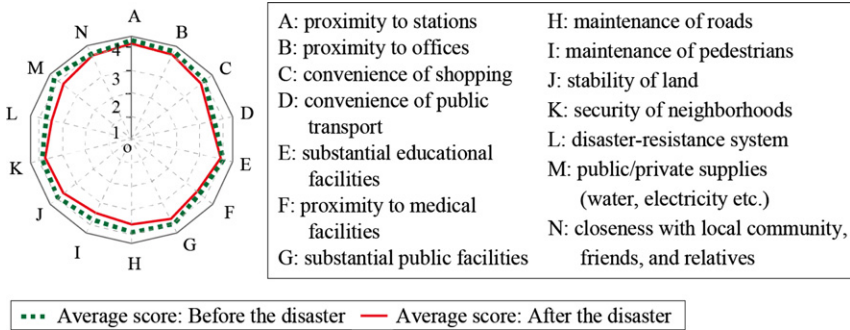


Fig. 10. Changes of the Residents' Perception to Their Residential Environment of Their Neighborhoods in Hitachi City (2012). Note: Adapted from Hashimoto et al. (2012). Source: Authors' Questionnaire Survey.

downgraded community scores after the disaster. Public and private supplies of energy, water, and sewage fell most in ranking, followed by the maintenance of roads and sidewalks. Surprisingly, many residents did not upgrade the scores of closeness with local communities, friends, and relatives. This stagnancy reflects diverse perceptions. Young residents, but not others, appear to have noticed the importance of their communities and upgraded these scores. If respondents were in the core regions of the disaster, the scores before and after it changed dramatically. As Heeren (1999) mentions, victims build up strong bonds with each other by sharing difficulties following a catastrophe; thus the scores of closeness with the local community are expected to rise.

Comments of Residents in a Coastal Settlement to the Disaster

Comments and requests presented by residents of a coastal settlement in Hitachi City were listed in Table 4. There were eight types of comments: (i) recovery of roads and sidewalks (22 answers), (ii) water supply (11), (iii) distribution of information (9), (iv) nuclear accident (8), (v) evacuation sites (12), (vi) Hitachi City and its officers (11), (vii) economic matters (8), and (viii) others and no comments (4 and 24 answers, respectively) which were excluded in the table. We can clearly see how people's lives are filled with uneasiness, confusion, and distrust to local and national governments.

Regarding such conditions, Hitachi City took several actions in 2012, for example, building emergency storehouses, conducting surveys on wells within the city, and modification of its hazard maps. Local communities,

Table 4. Comments on Disaster Responses by Residents in Coastal Settlement in Hitachi City (2011).

Types (Number of Answers)	Comments and Requests from Residents
Recovery of roads and sidewalks (22)	I worry about dangerous condition of roads and sidewalks in our city. After the earthquake, whenever trailers or big dumps pass the Route 245, we feel small quakes. Although it recovered apparently, it must be damaged underground.
Water supply (11)	We need a map of available well water for emergencies. People taught me locations of available well water and spring. It helped me so much. I hope the city subsidize its residents who own wells so that they can equip pumps under manual operation; local residents will be able to ask for water at power failure caused by natural disasters. All community centers, public facilities, and designated evacuation sites should sink wells in their lots.
Distribution of information (9)	I could not gain useful information about Ibaraki prefecture and Hitachi City. Most media information was limited to the Tohoku region. Besides emergency radios, we need emergency outside stereos. We could not understand any disaster information distributed by city's cars.
Nuclear accident (8)	"Fuhyo-higai" is serious. Please let people know that agricultural and aquacultural products in Hitachi are safe! As the Fukushima nuclear plant is relatively close to Hitachi, I want to know radiation level in Hitachi. We live 8 km away from Tokai-mura nuclear facilities. I wonder if these facilities consider measures for earthquake and tsunami. Urgent measures are necessary.
Evacuation sites (12)	We need safe evacuation sites!! Water, blankets, and foods We wanted them as much as we needed. Evacuation site was dark and cold, I preferred to stay at home. In addition to designated sites, we need storehouses for foods, water, blankets, and emergency power generators.
Hitachi City and its officers (11)	Hitachi City should distribute accurate information as much as possible. Although I went to a branch office to know when water and electricity services would recover, no officer could answer to it. Too late, too late. Officers were in the evacuation sites, but they could not do almost anything because the City did not give them orders.
Economic matters (8)	Housing recovery costs too much, and it's almost three times more expensive than usual. Daily goods became more expensive than before.

Note: 1. Free comments in authors' questionnaire surveys were used for the table. 2. In addition to the types of comments listed in the table, there were 4 comments classified as "Others" and 24 "No comments."

Source: Authors' questionnaire survey. Arranged in Hashimoto et al. (2012).

however, started to make their own disaster-prevention plans. Some core members of residents' associations mentioned that they would not believe the City, and they had to protect their residents by themselves. Conversation between the City officials and local communities are required in order to make sustainable and successful disaster management within the City. These comments can be the key to make better disaster-prevention plans and community-based urban planning for future.

These results may symbolize features of surrounding regions of disaster damages. People don't share the strong image that "we are victims of the disaster," they rather believe that only the people in the Tohoku region are the victims. Such image can affect people's perception of damages caused by the disaster. Although there are enough number of people whose houses are completely collapsed by tsunami in the same neighborhood, people may ignore this fact. In our interviews, some residents, who lost their house or forced to rebuild some parts of their house, had sighs over cruel opinions from other residents in the same neighborhood. They felt as if they were ignored by society, and that they had no right to talk about their hard time during and after disasters.⁷

DISCUSSION AND CONCLUSION

After the earthquake and tsunami, residents initially tried to go back to their homes. Depending on the damage, they remained in them, moved to relatives or friends' houses, or to neighborhood evacuation sites. The disruption of basic public services, transportation systems, and other damages limited the mobility of residents who had only the human and physical resources of their neighborhoods at their disposal. Therefore, the characteristics of local communities affected resident behaviors during and after the earthquake. Evacuation drills reinforced the operation of evacuation sites in a hillside community.

Shaw and Goda (2004) clearly explain that civil society is the base of a sustainable community. Leadership by residents' associations is crucial in the making of day-to-day and emergency decisions. Edgington (2010) emphasizes that cooperation between local authorities and residents (or residents' associations) was essential in Kobe's sustainable reconstruction plans. A human environment consists of more than buildings, roads, and parks; it also needs social networks, such as residents' associations or local small businesses (Kubo, Onozawa, Hashimoto, Hishinuma, & Matsui,

2010). Indeed, the leadership of local communities can diversify resident benefits, which become evident during natural disasters. Young Japanese do not join residents' associations or partake of community activities in urbanized areas. Although they may participate in NGOs or volunteer activities, they regard residents' associations as senior clubs. The earthquake and tsunami, however, gave young residents the chance to see that they were members of their neighborhoods. After the 1995 Great Hanshin-Awaji Earthquake, the involvement of local residents in policy making rapidly increased (Edgington, 2010). Although reconstruction from the 2011 Tohoku Pacific Earthquake has gone slowly, we clearly see greater local involvement and the power of grassroots activities into the rebuilding of local communities and in small-scale disaster preventions. Many university students and young people have joined volunteer activities in the disaster areas. Japanese society has started to build a sustainable civil society.

Community support activities and resident behavior indicate that the geography of the region or neighborhood matters in emergencies; both physical and human geography contribute to disaster reactions. As Kunugiza and Matsui (2005) note, our decision-making processes and area images are presented in a biased manner in mass media. Geography lessons contribute to better decision making in emergencies by offering regional knowledge to students, who will be very important actors in local communities in the near future. Those geography lessons will be discussed in our future studies.

NOTES

1. Wakabayashi (2009) notes that perceptual-behavioral geography enjoyed quite boom after the 1965 special meeting of the Association of American Geographers; its popularity peaked in the 1960s in the United Kingdom and in the late 1990s in Japan. The approach declined as geographers started to diversify their research interests. On the other hand, in the United States, perceptual-behavioral geography has gain great attention; now most studies with this method are published in the United States.

2. According to the Ibaraki prefectural Fisheries Administration Division, a total of 143 species of marine products and 163 kinds of processed marine products were examined to survey their levels of radioactive substances till May 28, 2013 in Ibaraki prefecture. Through these surveys, fishery and selling of marine products such as whitebaits (*Shirasu*), panther puffers (*Higan-Fugu*), gofers (*Usu-mebaru*), and so on started in the spring 2013 (http://www.pref.ibaraki.jp/nourin/gyosei/hou-syanou_jyouhou.html#2; accessed on May 31, 2013).

3. The JCO Nuclear Accident, which occurred in Tokai-mura village in September 1999, was a mishap in a uranium reprocessing facility operated by the

JCO, a nuclear fuel cycle company. A subsidiary of the Sumitomo Metal Mining Co., Ltd., it was founded in 1979. According to the International Atomic Energy Agency (IAEA), this accident was recorded as level four on the International Nuclear Event Scale (INES). Two people were killed and more than 660 were exposed to radiation. More than 160 residents living within a 350-m radius were asked to evacuate for five hours after the incident, and people in a 10-km radius were asked to stay indoors.

4. According to the report of the Japanese Reconstruction Agency, a total of 2,688 people were dead by the 2011 Tohoku Pacific earthquake and tsunami; 389 in Iwate prefecture, 862 in Miyagi prefecture, 2 in Yamagata prefecture, 1383 in Fukushima prefecture, 41 in Ibaraki prefecture, 4 in Chiba prefecture, and 7 in other prefectures in the Kanto region (March 31, 2013).

5. Most Japanese suburban neighborhoods, which were built from the 1960s to 1980s, have witnessed a period of maturation and generational transition (Nakazawa, Sato, & Kawaguchi, 2008). They are now less popular than city-center condominiums or new bay-area housing developments (Hirayama, 2005) and face serious social problems, such as aging populations and worsening residential environments (Naganuma, Arai, & Esaki, 2006).

6. Before 1947, when the *ie-seido* (patriarchal family institution) was abolished, the relationships of head family and its collateral families, at the same time family head and other family members in a household, were regarded as those of masters and servants. Head families took responsibility for the lives of collateral families. Such relationships have now weakened in Japan as a whole, but they can still be seen in rural and fishing communities.

7. Regionally biased images and their demerits are examined in our next studies. A part of our results has already been presented in the 2012 annual conference of the Japan Studies Association of Canada (JSAC), which was held in Ottawa in October 2012.

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APPENDIX

Table A.1. Annexure: Major Natural Disasters and Disaster Management Laws in Japan (1945–2010).

Major Natural Disasters or Events in Japan		Disaster Management Laws Designated After Natural Disasters or Events	
Year	Natural disasters or events	Year	Disaster management laws or conditions
1946	Nankai Earthquake	1947	Disaster Relief Act
1945	Typhoon Makurazaki	1949	Flood Control Act
1947	Typhoon Catherine		
1948	Fukui Earthquake	1950	Enacting Standard Law
1959	Typhoon Ise-wan	1960	Soil Conservation and Flood Control Urgent Measure Act
		1961	Disaster Countermeasure Act
		1962	Act on special financial support to deal with extremely severe disaster
1961	Heavy snowfall	1962	Act on special measures for heavy snowfall areas
1964	Niigata Earthquake	1966	Act on earthquake insurance
1973	Mt. Sakura-jima Eruption	1973	Act on special measures for active volcanoes
1973	Mt. Asama Eruption		
1976	Seismological Society of Japan of Tokai Earthquake	1978	Act on special measures for large-scale earthquakes
		1980	Act on special measures for urgent earthquake countermeasure improvement projects in areas with intensified measures
1978	Miyagi-ken-oki Earthquake	1981	Amendment of Building Standard Law Magnitude 7.8; a total of 201 people died
1993	Southwest off Hokkaido Earthquake		
1995	Great Hanshin-Awaji Earthquake	1995	Act on special measures for earthquake disaster countermeasures
		1995	Act on promotion of the earthquake-proof retrofit of buildings
		1995	Amendment of Disaster Countermeasure Act
		1995	Amendment of act on special measures for large-scale earthquakes
		1996	Act on special measures for preservation of rights and profits of the victims of specified disasters
		1997	Act on promotion of disaster resilience improvement in densely inhabited areas

Table A.1. (Continued)

Major Natural Disasters or Events in Japan		Disaster Management Laws Designated After Natural Disasters or Events	
Year	Natural disasters or events	Year	Disaster management laws or conditions
		1998	Act on support for livelihood recovery of disaster victims
1999	JCO nuclear accident	1999	Act on special measures for nuclear accident
1999	Torrential rains in Hiroshima	2000	Act on promotion of sediment disaster countermeasures for sediment disaster-prone areas
2000	Torrential rains in the Tokai region	2001	Amendment of Flood Control Act
		2003	Special Urban River Inundation Countermeasures Act
2004	Niigata-Fukushima torrential rains, etc.	2005	Amendment of Flood Control Act
		2005	Amendment of act on promotion of sediment disaster countermeasures for sediment disaster-prone areas
2004	Niigata-Chuetsu Earthquake	2005	Amendment of act on promotion of earthquake-proof retrofit of buildings
		2006	Amendment of act on the regulation of residential land development

Source: Arranged by Cabinet Office, Government of Japan (2011).