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Counter Disaster Measures for People with Functional Needs in Times of Disaster in Japan: Achievements and Challenges before and after the Great East Japan Earthquake and Tsunami Disaster

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Abstract

This paper reports, first, the achievements to counter disaster measures for People with Functional Needs in Times of Disaster (PFND) in Japan since 2004, second, the newfound challenges following the 2011 Great East Japan Earthquake and, finally possible solutions to address these issues. First, a case study conducted at Hyogo ward, Kobe city was presented as an attempt to propose a standardized method of identifying and locating individual PFND based on person-in-environment model of vulnerability. After the 2011 earthquake and tsunami disasters, newfound challenges were observed: Those were (1) identifying people at risk; (2) assigning specially designated shelters for PFND; (3) utilizing the information on PFND. Identifying people at risk relied on the current hazard estimation process which is based on the maximum probable event (MP_rE) framework. It was found, however, that there is a need to re-think this and shift to the maximum possible event (MP_oE) framework. The need for shelters and temporary housing units that can respond to individualized needs of PFND arose following the earthquake. However, due to lack of pre-planning in some municipalities, their provisions were neither systematic nor universal. Meanwhile, lack of understanding of the legal framework influenced the reluctance of many local government administrators not to share their PFND registry to Non-governmental Organization (NGO) or self-help organizations. Since a majority of people with disabilities, one large category of PFND, chose not to seek assistance from the evacuation shelters,

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they became invisible and the local administrators were unaware of their specific needs. To address these issues, the following were proposed; (1) a shift from MP_rE to MP_oE framework which calls for the involvement of all stakeholders; (2) developing a more detailed guidelines for specially designated shelter and temporary housing operations; and (3) public education on the use of personal information of PFND during a disaster period.

Keywords: People with functional needs in times of disaster, Counter-disaster measures, Maximum probable event, Maximum possible event, Mapping vulnerability

INTRODUCTION

Japan's Counter-Disaster Measures for People with Functional Needs in Times of Disasters

The issue of people with functional needs for communication, medical care, maintaining functional independence, supervision, and transportation (Kailes & Enders, 2007) during disasters received high attention since 2004, when strong typhoons, heavy rain fall and the Niigata-Chuetsu earthquake hit the Japanese archipelago causing severe damage and losses, especially among elderly and people with disabilities. 60% of the natural disaster victims in 2004 were over the age of 65.

The Japanese Cabinet Office immediately took action by creating a committee of experts by autumn of 2004. The committee examined the necessary counter-disaster measures to facilitate evacuation and sheltering assistance for people with the aforementioned functional needs for communication, medical care, maintaining functional independence, supervision, and transportation in times of disaster. On March 2005, the following year, the committee came up with the first edition of the "Evacuation/Sheltering Assistance Guideline for People with Functional Needs in Times of Disasters" (Committee on Disaster Information Communication and Evacuation/Sheltering Assistance for the Elderly/Disadvantaged Population during Heavy Meteorological and Other Disasters, 2005). Here the PFND or *saigaiji-youengosha* is defined as "A person who is able to function daily, whereby living independently given the proper resources and services when necessary." However, in times of disaster these services that provide social safety nets may cease to function or may not reach them for a prolonged period causing them harm or difficulty.

The publication of this guideline introduced and popularized the use of *saigaiji-youengosha* in lieu of elderly and vulnerable person or *saigai-jakusha*. The new terminology also shifts the focus of disaster counter measures from the inherent vulnerability of the person to understanding how society can meet their functional needs even in time of disaster (Comafay, Kitahama, Tobioka, & Tatsuki, 2008; Hayashi & Tamura, 2005; Ochi & Tatsuki, 2007; Tamura, Hayashi, & Tatsuki, 2005).

When the first edition of the guideline was published, another series of meteorological disaster hit Japan in 2005. This prompted another Cabinet Office committee to conduct a field research of the heavy rainfall, flood and land slide disaster sites (Committee on Evacuation/Sheltering Assistance for People with Special Needs in Times of Disaster, 2006). The result of this was published on March 2006 containing revisions to the evacuation and sheltering assistance guideline for PFND. The revised guideline put emphasis on the three necessary measures. First, each municipal government should establish a special team that will be in charge of coordinating assistance to the target population. Second, the information on the functional needs population is encouraged to be shared within different offices of the local government and, if possible, with

the local community organizations (e.g., neighborhood associations and community emergency and response teams). Third, planning of evacuation and sheltering procedures for PFND.

In 2006, the same committee continued working out more detailed procedures and workflow on how to collect or share information on PFND and suggestions on how to create individualized evacuation/sheltering assistance plans. In the subsequent year, March 2007, the committee published the report on preparedness procedures for People with Functional Needs in Time of Disaster (Committee on Public Welfare and Disaster Prevention Coordination in Evacuation/Sheltering Assistance for PFND, 2007). The 2007 report emphasized the establishment of a system to assist PFND by facilitating cooperation between the local government disaster preparedness/response and health/welfare departments. The disaster preparedness division will provide local hazard information while the health and welfare division will provide information on the potential vulnerabilities within the target population. The 2007 report also encouraged the use of maps to locate and identify PFND who are exposed to potential hazards. The geographical location (or residence) and attributes of frail elderly and people with disabilities (PWD) when projected onto multiple hazard layers (e.g., flood, landslide, and seismicity) will provide visual identification of who are at more risk due to their functional needs and their geographic locations.

To encourage the implementation of the 2006 revised guideline and 2007 report, the Fire and Disaster Management Agency (FDMA) sent a request to every municipality in Japan to come up with its own master plan which would facilitate policy formation on assisting PFND during a disaster. This master plan should identify the potential target groups and clarify the proper procedure of collecting and sharing their personal information. Individualized evacuation plan for PFND based on this master plan was also encouraged. The municipalities were further advised to actualize the plan by recruiting and assigning local resident helpers to PFND individuals.

As of April 1, 2011, as a result of a survey conducted by FDMA, 76.8% or 1,262 out of 1,644 municipalities have successfully completed a PFND assistance master plan. Meanwhile, 21.2% or 349 municipalities were on the process of completing their master plan within one year from the survey. Furthermore, 52.6% or 864 municipalities reported that they have finalized and have been updating their database PFND containing directory, while 41.5% or 683 municipalities were currently in the process of creating a directory. Most municipalities have also started the time consuming process of assigning local residents/helpers to each PFND to assist in their evacuation; 22% or 361 reported that they have completed the assignments, 60.7% or 998 are still in the process, and 17.3% or 285 have not yet started (FDMA, 2011).

The Hyogo Ward, Kobe City PFND Mapping Project

The Kobe city administration collected social service recipient database from different departments and came up with an integrated registry. Out of 1.5 million residents, the integrated registry involved approximately 120,000 individuals living in Kobe city who were considered as potentially vulnerable during a disaster. Tatsuki and Comafay (2010) and Comafay (2011) reported on the 2008 Kobe PFND Mapping Project, which assessed the overall vulnerability of PFNDs to the potential multiple hazards in the area by combining geographical information system and social survey results. The report focused on the 107-thousand-resided Hyogo ward wherein 4,411 people with physical disabilities[1] (PWDs) were identified based on the Kobe city integrated registry. The Hyogo ward encompasses both mountainous areas in the north and coastal areas in the south and thus exposed to landslide, flooding and tsunami hazards. The 4,411 PWDs were geocoded and then mapped on the multi-hazards layers and 914 individuals with physical disabilities were found to be residing in hazardous areas (see Figure 1).

Interviewers visited these 914 individuals to conduct a social survey to further understand other factors that could contribute to their vulnerability which were not reflected in the registry. 67% or 612 responded to a structured questionnaire administered by the interviewers.

The information gathered from the structured questionnaire included: (1) demographics; (2) level of disability; (3) social isolation; (4) housing fragility; and (5) physical immobility. Demographics variable was concerned about the age category (65 years old and below, 65-75 years old, 75-85 years old and 85 years old and above); sex (male, female); and occupational status (employed, student, and

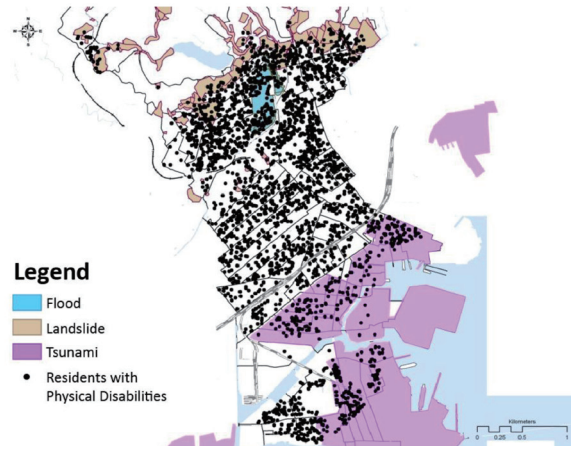

Figure 1. Persons with disabilities living in Kobe's Hyogo ward (N = 4,411).

[1] This includes those with (1) limb/trunk impairment; (2) hearing impairment; (3) visual impairment and (4) with internal disorders, including those with pacemakers (heart conditions), respiratory apparatus (including, lung complications), digestive apparatus (stomach and intestinal problems) and those in need of dialysis (kidney problems).

unemployed) of the respondent. Physical disability variable measured the level of disability (ranging from class 1 to 6, where 1 is the highest); certification of the Long Term Care (LTC)[2] status (ranging from support required 1 and 2 and care levels 1 to 5, where care level 5 is the highest) and type of disability (motor dysfunction, visual disability, hearing disability and internal disorder) among others. The third set of variables inquired the degree of social isolation that was measured by types of social welfare and LTC services being used, family structure, if he or she being alone during day time, type of key person (person to rely on in case of emergency), and key person's address. The fourth variable is housing fragility (building age) and hazard exposure risk (bedroom on the first, second floor or above). Finally, physical immobility variable measured the ability of the respondent to evacuate alone (ability to walk alone, with assistance and cannot walk), number of local helpers needed to evacuate, special medical equipment and medicine needed for everyday living, ability to walk up and down stairs, and ability to use Japanese style toilet

The person-in-environment (PIE) model of vulnerability, which defined hazard vulnerability (V) as a function of hazards (H), person (P), and environment (E) factors or $V = f[\, H, f\,(P, E)\,]$, was used to analyze the 2008 Kobe mapping project. Based on this model, the following steps were performed to analyze the data and produce the maps used for analysis in this paper. (1) Using optimal scaling method (also known as dual-scaling), an index of scores containing the 5 variables was derived. The 5 variables were then classified into three factors according to the PIE model. These are: (i) Person factor which includes demographic variable, physical disability variable and physical immobility variable; (ii) Environment factor which includes housing fragility; and (iii) interaction between Person and Environment factors or P × E factor which includes social isolation variable. (2) the overall social vulnerability score was then calculated using the mean of these 5 variables for each respondent; (3) each respondent was plotted over the hazard layer using the individual's addres ; (4) to visualize the geographical distribution of the respondents, maps were created using GIS according to each variable score (demographics, physical disability, social isolation, housing fragility, and physical immobility) and using the overall vulnerability scor ; (5) the overall vulnerability score map was then divided into 4 categories according to degree of vulnerabilit ; (6) weighted kernel density mapping was performed using the overall vulnerability as weight. This was then combined using raster calculator to derive the overall density.

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[2] The Long Term Care (LTC) Insurance program in Japan was introduced in 2000. Individuals 65 years old and above are generally eligible for LTC services. However, individuals 40-64 years old may apply for "long term care certification" from the municipality to be eligible for LTC services. Services range from home care visits from home helpers and use of special nursing homes for the elderly (Ministry of Health, Labor and Welfare, 2002).

The Person-in-Environment model proposes 3 factors to assess individual vulnerability and these are; person or (P) factor, Environment or (E) factor and the interaction of person with its environment or (P) by (E) factor. This section presents the results of the dual/optimal scaling and mapping result of the 5 variables: (1) demographics; (2) levels of disability and/or long-term care; (3) social isolation; (4) vulnerability of housing; and (5) physical immobility. The 3 variables that were categorized as person (P) factor were demographics, physical disability and physical immobility variables. Environment (E) factor was represented by the housing condition variable, while degree of social isolation variable features the (P) by (E) factor. The category weights were taken as the vulnerability score of each variable and shown from Tables 1 through 5. The result of the dual/optimal scaling indicates that the lower the negative value gets, the higher the degree of vulnerability of the respondents become. These variable score were then mapped as shown from Figures 2 to 6.

Person Factor

Demographic Variable

Table 1 shows the result of the dual scaling analysis for demographics variables. The results show that female, 85 years old and above and non-employed derived negative scores within their category. According to the Ministry of Health, Labor and Welfare (2002), Japanese females are expected to live until 86.44 years, while men only up to 79.29 years. Therefore, it can be inferred that the gender category result is related to the fact that there were women respondent who were 85 years old and above. Meanwhile, PWD have more difficulty getting employment due to their handicaps, while the elderly may have already retired and in fact 86% of the respondents were non-employed. Older adults have higher vulnerability in times of disaster because they are less likely to evacuate their homes alone, more likely to experience emotional trauma due to losses or damage incurred from disaster, most

Table 1. Category weight result of demographic variable

		Frequency	Category Weight
Sex	Male	276	0.599
	Female	336	-0.494
Age Category	65 years old and below	160	1.299
	65 to 75 years old	184	-0.304
	75 to 85 yeard old	119	-0.304
	85 years old and above	149	-0.752
Occupational Status	Employed	56	2.231
	Student	8	1.326
	Non-employed	527	-0.255

likely to reside in structurally fragile housing and compared to children they are less likely to receive assistance (Bolin & Klenow, 1983; Cohen & Poulshock, 1977; Friedsam, 1961; Penner & Wachsmuth, 2008). Meanwhile, the non-employed may experience socio-economic marginalization that makes them more vulnerable, such as having to live in cheaper, less structurally sound housing.

Figure 2 shows the mapping of the respondents based on the result of their demographic category weight scores. The big, red circle represents individuals who are female, over the age of 85 and non-employed. There is a concentration of respondents who are more vulnerable due to their demographic characteristics in the northern area of the map.

Physical Disability

As for level of disability and care, only physical disability and having certification of LTC showed significant variance within its category (see Table 2). In terms of physical disability class category, all levels and all types of physical disability scored negative. Individuals who did not utilize services such as day care facilities, work place for PWD, and nursing home scored negative. Negative category weights were also produced in LTC levels, except for level 4. Finally, due to the small number of

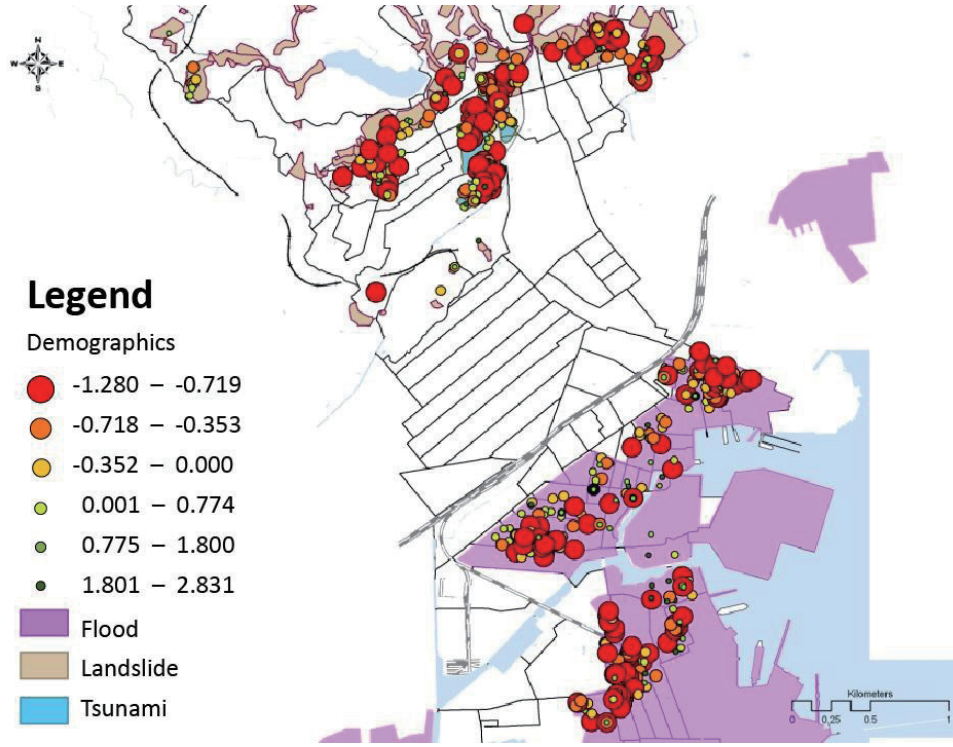

Figure 2. Result of mapping vulnerability scores: Demographics.

Table 2. Category weight result of physical disability variable

		Frequency	Category Weight
Disability	Physical Disability Handbook	592	-0.211
	Mental Disability Handbook	34	5.669
Physical Disability Hanbook Class	1st Class	254	-0.037
	2nd Class	168	-0.260
	3rd Class	55	-0.343
	4th Class	79	-0.398
	5th Class	15	-0.246
	6th Class	21	-0.851
Physical Disability Type	Motor Dysfunction	347	-0.121
	Visual Impairment	93	-0.271
	Hearing Impairment	9	-0.577
	Medical Dependence	153	-0.212
Grade of Mental Disability	A1	30	5.975
	B1	3	2.839
	B2	1	5.007
Living Condition	Certification of Long-Term Care	276	-0.214
	Others	58	1.454
Day Care Facilities	Using	127	0.711
	Not Using	471	-0.163
Work Place for PWD	Using	10	2.785
	Not Using	590	-0.026
Home Visit Helper	Using	194	0.021
	Not Using	406	0.020
Nursing Home	Using	56	1.260
	Not Using	544	-0.107
Long Term Care Level	Support Required 1	24	-0.515
	Support Required 2	52	-0.530
	Care Level 1	44	-0.307
	Care Level 2	41	-0.048
	Care Level 3	54	-0.139
	Care Level 4	29	0.175
	Care Level 5	32	-0.040

sample with Mental Disability Handbook the category weight produced significantly high scores.

Figure 3 is the mapping result of the vulnerability of respondents due to their disability, LTC status and use of social welfare services. In the map, the bigger circle represents individuals who extremely vulnerable due to there disability and reliance to LTC service. The map shows that they are located much more dispersedly

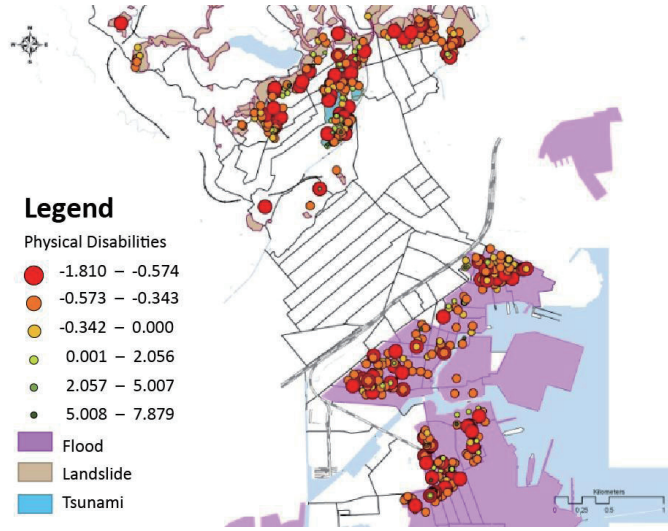

Figure 3. Result of mapping vulnerability scores: Physical disability.

Physical Immobility

Finally, physical immobility variable revealed that those who have difficulty with mobility are the most vulnerable. Table 3 shows that individuals who have cannot walk, needing 2 or more people to assist them in evacuation, need a wheelchair to walk around, cannot go up and down the stairs, those who need oxygen tank for daily living, and persons who cannot use Japanese toilet have negative scores. These results convey that these individuals have a higher degree of functional needs. Functional needs are tools or human assistance that is required by a person due to his or her disability. It can be as simple as a cane to allow them better mobility; or it can be medically related such as an oxygen tank to assist their breathing during evacuation. It can be as complex as providing shelters which is specially equipped, following the universal design, to respond to their access needs.

Figure 4 shows the mapping result of the respondents based on their functional needs category weights. This map locates the individuals with mobility restrictions, where individuals with higher degree of functional needs are shown in bigger circle.

Environment Factor: Housing Condition

The housing condition scale (see Table 4) was derived using Dual Scaling method. This scale showed that wooden houses, low-rise apartment buildings and age of building 30 years and older derived negative scores, thus houses with these scores are more fragile. On the other hand, bedrooms the first floor were weighted negatively, supporting the assumption that people who live on the first floor are more exposed to tsunami and flooding hazard.

Table 3. Category weight result of physical immobility variable

		Frequency	Category Weight
Mobility	Can walk alone	388	1.272
	Need Assistance	101	-1.142
	Cannot walk	109	-2.851
Number of Assistance Needed	1 person	87	-1.138
	2 person	9	-2.198
	3 person	1	-5.542
Special Requirement for Moving	Wheelchair	148	-2.171
	Cane	186	0.361
	Others	31	-0.484
Going Up and Down Stairs	Can	183	1.810
	Can if there is handrail	220	0.692
	Cannot	184	-2.182
Medical Instruments and Tools Necessary for Everyday Living	Artificial Dialysis	50	0.945
	Pacemaker	49	1.182
	Artificial Respirator	4	-0.130
	Oxygen Tank	12	-1.290
	Artificial Colostomy	8	1.279
	Others	41	0.441
Toilet Conditions	Japanese and Western Style	143	1.891
	Western Style Only	429	-0.230
	Others	13	-3.735

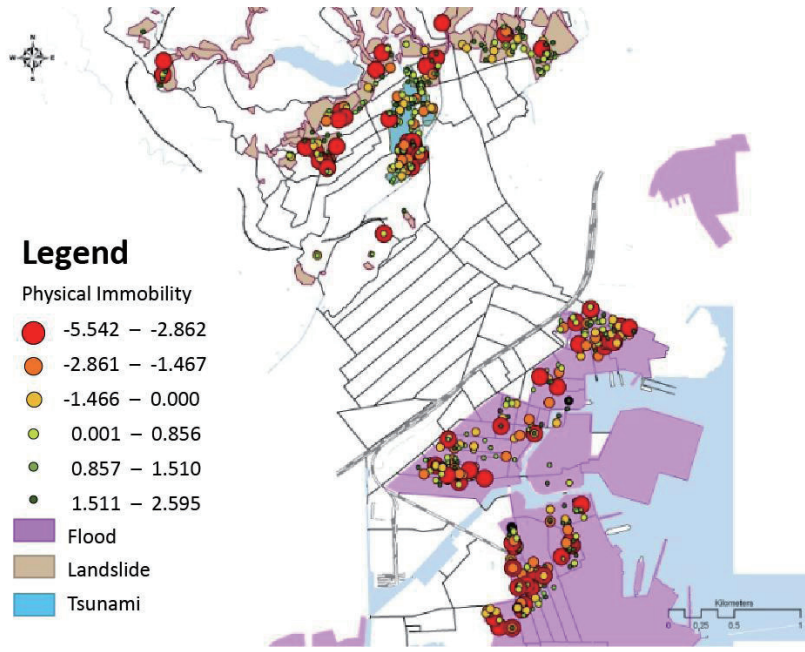

Figure 4. Result of mapping vulnerability scores: Physical immobility.

Table 4. Category weight result of housing condition variable

		Frequency	Category Weight
Building Structure	Wood	339	-1.124
	Reinforced Concrete	258	1.115
	Others	6	-0.637
Building Age	15 Years and below	142	0.287
	15-30 Years	164	0.474
	30-44 Years	105	-0.100
	44 Years and above	130	-1.334
Building Category	Single House	327	-0.636
	Medium to High Rise Apartments	203	1.628
	Low-rise Apartment	50	-2.464
	Others	29	-2.998
Number of Floors (Single House)	1st Floor	26	-1.290
	2nd Floor and Above	479	0.346
Floor No. of Bedroom (Single House)	1st Floor	158	-0.775
	2nd Floor and Above	96	-0.468
Number of Floors (Mansion)	1st Floor	1	-0.152
	2nd Floor and Above	199	1.642
23 Floor No. of Bedroom (Mansion)	1st Floor	44	1.652
	2nd Floor and Above	156	1.633
Number of Floors (Apartment)	1st Floor	1	-3.495
	2nd Floor and Above	47	-2.416
Floor No. of Bedroom (Apartment)	1st Floor	23	-2.551
	2nd Floor and Above	24	-2.311
Number of Floors (Others)	1st Floor	5	-3.483
	2nd Floor and above	19	-3.068
Floor No. of Bedroom (Others)	1st Floor	15	-3.349
	2nd Floor and Above	9	-2.452

Figure 5 shows the mapping result of the respondents who live in fragile housing and are more exposed to tsunami and flood hazards based on the housing condition scale. Those residents in wooden housing and older structures are concentrated in the northern part of Hyogo ward where the older neighborhood is located. This area is also characterized by its aging population and low birth rate (Kobe City, 2009).

P × E Interaction Factor: Social Isolation

The P × E factor is derived from the social isolation variable. Those who were living alone, not living with their contact person (in case of emergency), address of family member outside of Hyogo ward, and those who have no one to depend on in case of emergency have a high degree of social isolation. Table 5 also shows that

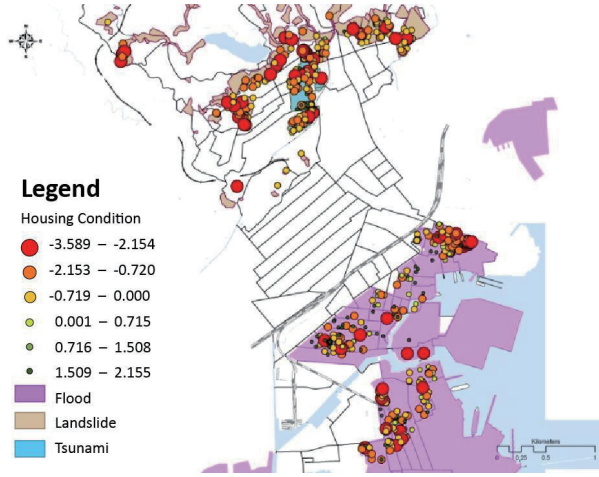

Figure 5. Result of mapping vulnerability scores: Housing condition.

Table 5. Category weight result of social isolation variable

		Frequency	Category Weight
Household Size	Single household	219	-1.975
	2 persons and above	388	1.165
Household Structure	Couple Only	170	0.271
	Living with Child/Children	143	1.703
	Living with Parent(s)	39	2.807
	Others	35	1.454
	Living alone	216	-1.983
Contact Person in Emergency	Exists	547	0.221
	Not existing	59	-1.580
Who to Contact in Case of Emergency	Child or Spouse of Child	329	0.144
	Parent	53	2.459
	Sibling	89	0.369
	Neighbor	89	-0.466
	Welfare Service Provider	42	-0.223
	Others	45	-0.009
	Spouse	32	1.603
Location of Contact Person	Neighbor	161	-0.255
	In Hyogo Ward	147	0.326
	In Kobe City	127	-0.696
	Other Area	52	-0.796
	Living together	98	2.459
Family Member to Contact in Emergency	Parent	54	2.365
	Sibling	116	-0.028
	Child	347	-0.010
	Spouse of child	18	1.204
	Others	85	0.189

Table 5. Category weight result of social isolation variable (Continued)

		Frequency	Category Weight
Living Condition of Family Member	Living Together	137	2.466
	Living Separately	370	-0.656
	Both	19	1.461
Address of Family Member	In Hyogo Ward	221	0.053
	In Kobe City	370	-0.670
	Others	96	-0.937
Living Condition of Respondent	Physically Disabled Only	257	-1.679
	Bedridden	33	0.627
	Alone during daytime	116	-0.692

households with only PWD residents and respondents who are alone during daytime were among those who are socially isolated.

The mapping result of vulnerability scores according to social isolation variable is shown in Figure 6. A big cluster of individuals who are measured as having high vulnerability due to their social isolation is located in the south east part, which is the industrial area of Hyogo ward where big factories are located (Kobe City, 2009). As shown in the map, these respondents are especially vulnerable to situations requiring evacuation to higher grounds, such as tsunami hazards which this area is exposed to. Therefore, individuals who have difficulty with mobility and are socially isolated become extremely vulnerable during emergency evacuation. Increased efforts are necessary to assign local helpers to assist individuals who are socially isolated, especially in the areas where they are highly concentrated.

Composite Vulnerability Index

Figure 7 represents the overall combined average of the vulnerability scores from the 5 variables discussed above. This map shows the geographical distribution of the respondents as well as their composite vulnerability score. Respondents calculated as having high level of vulnerability are shown in red circle. According to the result of the data, they were female respondents, 65 year old and above and unemployed, while their level of physical disability and long term care, degree of physical immobility, housing fragility and degree of social isolation are high.

There were 101 persons, about 17% of the 612 persons who responded to the survey, who were found to be living within the areas exposed to the multiple hazards in Hyogo ward having the highest overall vulnerability score. If this value is extrapolated to the total number of 972 persons exposed to the multiple hazards in Hyogo ward, we can estimate that there are about 165 PFND in Hyogo ward requiring individualized evacuation plan, such as local helpers to assist them during emergency

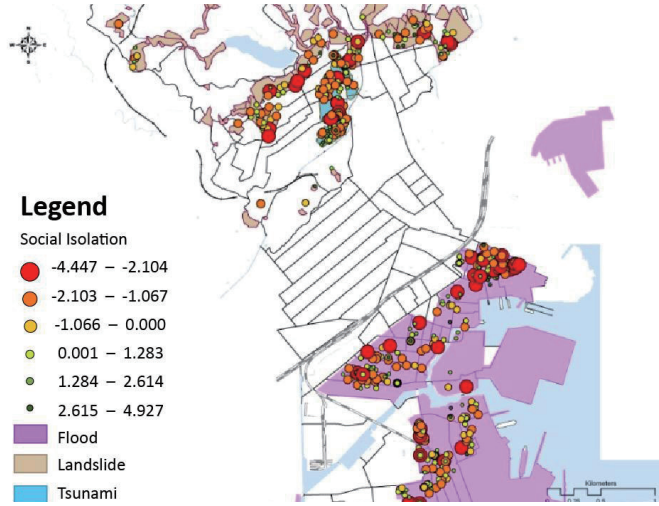

Figure 6. Result of mapping vulnerability scores: Social isolation.

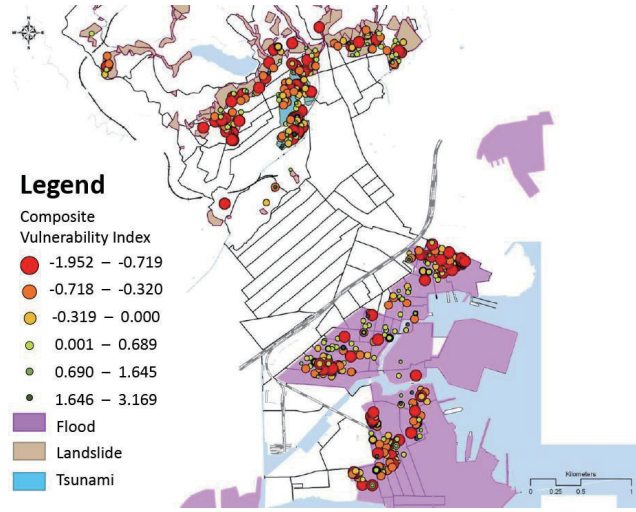

Figure 7. Result of mapping vulnerability scores: Composite vulnerability index.

evacuation, staying in special shelter, ensure continuous care for their medical needs during disaster to name a few.

While identifying and locating individuals with the highest vulnerability is important as preparation for counter-disaster measures for PFND assistance, identifying areas with high concentration of PFND is also crucial. A social vulnerability weighted kernel density map was generated from the composite index vulnerability map. Figure 8 is a map showing the density of population of people with functional needs and thus requiring more human resources and preparation during evacuation and sheltering in times of disaster.

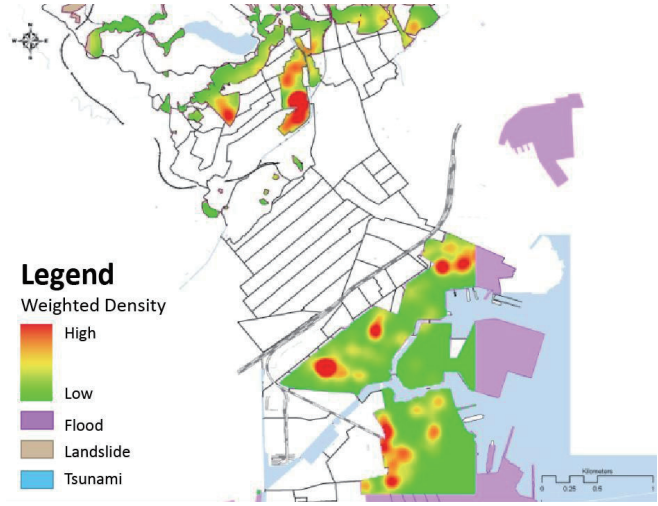

Figure 8. Weighted density map of PFND.

The 2008 PFND mapping project in Hyogo ward, Kobe city was an attempt to provide a standardized method of locating and identifying PFND through comprehensive analysis of the person and their interaction with their environment. Different stakeholders can utilize these social vulnerability maps of PFND as a tool to have a better grasp of the risks affecting their community. Furthermore, these stakeholders, such as functional needs groups, community emergency response teams, community social services, and emergency management centers, can utilize the vulnerability map to initiate evacuation and sheltering assistance planning in their respective areas.

Newfound Challenges to PFND Counter-Disaster Measures after March 11, 2011

Three preliminary field works were conducted from March to April after the onset of the March 11 Great East Japan Earthquake and Tsunami Disaster. The reconnaissance mission revealed the different serious problems encountered by PFNDs and their families, including their communities and municipalities. These problems presented newfound challenges to the efforts of national and local administrations to create better counter-disaster measures for PFND.

Major challenges were identified in different aspects of the disaster process including preparedness, response and relief measures for PFND. These challenges can be summarized as follows: (1) challenges in identifying people at risk by re-thinking “correct” hazard estimates; (2) challenges in assigning specially designated shelters for PFND before a disaster; and (3) challenges in the use of information on PFND.

Re-thinking Hazard Estimation Method to Identify People at Risk

The assumption that physical hazard maps give a "correct" representation and estimates of the areas exposed to future hazardous events is crucial in the recent developments in pre-disaster preparedness planning for PFND. For example, the suggested method of vulnerability mapping in the previous section relies on the PIE model of hazard vulnerability. According to this model, vulnerability (V) is a function of hazard (H), person (P) and environment (E) factors or V = f [H, f (P, E)]. Incorporating the exposure of individuals to physical hazards can provide a more comprehensive method of identifying people at risk.

However, as illustrated in Figure 9, there is a need to review existing hazard maps. These hazard maps are created using the framework that assumes the *maximum probable event* (MP_rE). However, the *maximum possible event* (MP_oE) has in fact occurred in the Tohoku region which has far exceeded the *maximum probable event*. The uncritical reliance on the abovementioned assumptions may result in devastating effects.

Using the currently implemented hazard factor estimation using the *maximum probable event* framework, the PIE model could be represented as V = f [MP_rE, f (P, E)]. The aftermath of the March 11 disaster however implies the fundamental challenge of re-thinking how hazards are estimated from assuming the *maximum probable event* hazard to finding a way to incorporate the *maximum possible event*. The modified person-in-environment model will therefore be represented as V = f [MP_oE, f (P, E)] to incorporate the *maximum possible event* framework in estimating vulnerability.

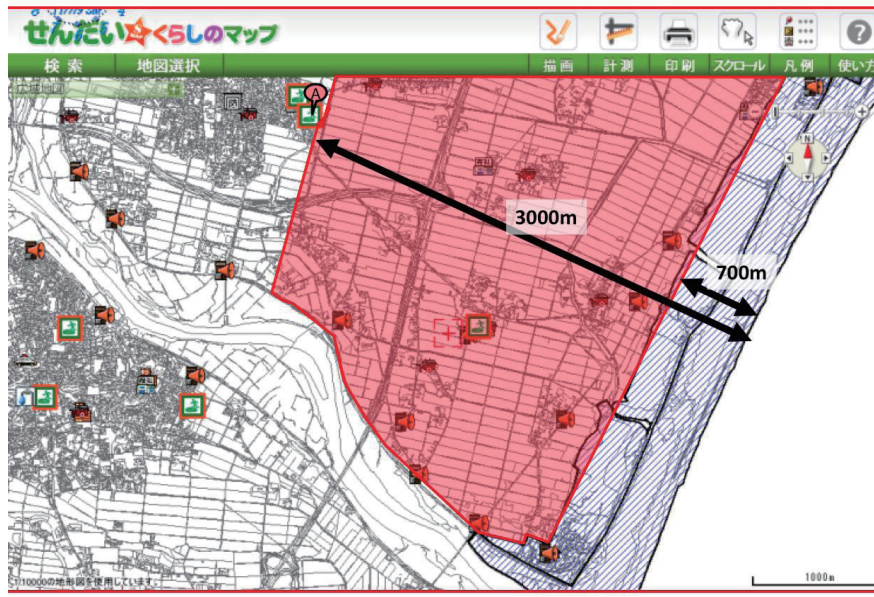

Figure 9. Comparing the tsunami hazard map and actual inundation east of Rokugo Junior high school, Wakabayashi ward, Sendai City.

The process of hazard estimation suggested by utilizing the MP_oE framework breaks out from the world ruled by probabilistic and statistical theorem (i.e., MP_rE framework) and enters into a different realm of "hyper-complexity" wherein "hypothetical knowledge can no longer be mastered by mechanical testing rules" (Beck, 1992: 157). This alternative state, according to Beck (1992: 156) is a "demonopolization of scientific knowledge claims." In effect, the new *maximum possible event* framework will demand for a "reflexive scientization" that necessitates the active coproduction by every stakeholder in society (Beck, 1992: 157). In other words, politicians, people who engage in business and the general public as well as the scientific community will be required to engage into the knowledge definition process.

The process of reflexive scientization call for public engagement, on the other hand demanding respect for both the locally exchanged tacit knowledge and the collective sensibilities of "lay actors" (Mythen, 2004; Wynne, 1996) and for the formal knowledge and technologies of experts. Thus producing an amalgam of tacit and formal knowledge to understand the correct way to estimate hazard using the *maximum possible event* framework is found. This challenge of re-thinking how we perceive risk and identify people at risk will be explored in further studies.

Pre-Planning Specially Designated Shelters for PFND

Following the March 11 earthquake, the general population evacuation shelters, such as that shown in Figures 10 and 11, were not equipped to meet the access and functional needs of PWD and the frail elderly. This has highlighted the need for shelters and temporary housing units that were specially designated for PFND. Unfortunately, due to lack of pre-planning, provision of specially designated shelters and temporary housing units were neither systematic nor universal in the affected areas.

The lack of pre-planning can be partly attributed to the fact that the 2006 guideline or the 2007 report has failed to include detailed procedures on sheltering assistance planning for PFND. While the concept of specially designated shelters for PFND or *fukushi-hinansho* emerged from the discussions by the 2004 committee on "Communicating Disaster Information and Evacuation and Sheltering Assistance for the Elderly and Other Population during Heavy meteorological and Other Disasters." The committee failed to clarify the requirements relating to specially designated shelters for PFND.

Furthermore, as can be gathered from title of the committee, since 2004, they have mainly conducted field studies in areas affected by meteorological hazards. From this they found that sheltering needs were short-term and considered as being less life-threatening than evacuation needs. Thus, as discussed in the earlier section, the counter-disaster measures for PFND in Japan have mainly focused on warning and neighborhood-based evacuation assistance activities.

Figure 10. Shelter at Rokugo junior high school gym in Sendai City (photo taken on April 6, 2011).

Figure 11. Residents of Arahama sheltered on a 1st floor classroom in Hakken junior high school (photo taken on April 6, 2011).

Due to the massive scale of the March 11 earthquake and tsunami disaster, the aftermath saw a very large number of people affected by the disaster rushing to the general population shelters and staying their much longer. This resulted in general population shelters, usually gymnasiums and classrooms of public schools, which were crowded and ill-equipped to provide accessibility (e.g., toilets, stairs, etc.). This situation has created high functional needs from PFND and made apparent the necessity of alternative shelters.

Despite of this apparent need to provide special designated shelters for PFND, the responses from different municipalities affected by the disaster were inconsistent. Below are examples of three municipalities and how they responded to the sheltering needs of the PFND in their area.

In the case of Sendai city, the city administration was able to make compacts, prior the March event, with 52 local social services providers to pre-plan alternative sheltering services for PFND. Moreover, the year before the disaster, some of those compacted shelters conducted study seminars and practice drills to increase their preparedness. Due to these pre-disaster measures undertaken by the city administration and local social services providers, some of these shelters were able to respond quickly to upon request by the city administration, while others were even able to voluntarily initiate operations of their shelters. As a result, a total of 26 shelters operated and served about 260 individuals in Sendai city (see Figure 12).

Since the downtown center of Ishinomaki city was severely damaged by the March 11 tsunami many people were forced to evacuate to the general population shelters. At its peak, about one fifth of its population or more than 30,000 people occupied these shelters.

It should be noted that Ishinomaki city was recognized as one of the ten model municipalities for creating a counter-disaster measures master plan for PFND as early as year 2004. By the end of the previous year before the disaster, about 401 out of 421 administrative districts in the city were able to complete their individualized evacuation planning for each PFND residing in the neighborhood. While it was renowned for its city wide community-based evacuation planning initiatives for PFNDs the city's master plan for PFND did not include provisions on specially designated shelters.

Figure 12. Specially designated shelter at Miyagino day service center for PWD, Sendai City (April 5, 2011).

In one of the large general population shelters, a medical doctor who was helping the sheltered population saw the need for an alternative shelter for the PFND population. He strongly demanded the city administration to provide special designated shelters for the frail elderly, PWDs and those out-patients who did not require intensive medical care from the tsunami unaffected Ishinomaki Red Cross hospital. In response to this request, the city temporally set up a special shelter at the Inai junior high school gym. The 20 to 30 special shelter occupants were later moved on March 29 to Yugakukan Sports Center gym, as shown in Figure 13. Eventually, the number of people who stayed at this shelter reached about 130 people, including PFNDs and their family members. Initially, the staff who took care of the daily operations of the Yugakukan shelter were mostly Ishinomaki Municipal hospital doctors, nurses and social workers who lost their work place due to the tsunami disaster. Starting from early April, doctors, nurses, social workers, nursing care workers and public administrators from other prefectures arrived as volunteers to assist the local service providers in the shelter operations.

While the city hospital doctors and nurses, with support from the city administration, were able to improvise operations of Inai junior high school and later Yugakukan shelter, it was not until almost the end of April that the city formally designated Yugakukan as a specially designated shelter for PFND. It was later learned that the Ishinomaki city administration was not aware of a special service provision clause under the Disaster Relief Act that qualifies municipalities with additional financial compensations from the national government in addition to the general service provisions. In the case of Ishinomaki city, specially designated shelters were in operation but for a prolonged period of time its operation lacked a formal logistic support foundation relying on the improvisation of the local service providers.

Figure 13. A specially designated shelter at Yugakukan Sport Center Gym in Ishinomaki City (photo taken from The Nippon Foundation, 2011).

Kesennuma city was also devastated by earthquake and tsunami attack in March and like Ishinomaki city, and about one sixth of the city population (more than 12,000 people) rushed to the general population shelters. Similarly, there were no specially designated shelters immediately available for the frail elderly, PWDs and small children. The PFNDs were all mixed with other evacuees who also looked after those in need at the general population shelters. To provide them some privacy, some shelters used cardboards as partition cardboards to separate the PFND from the general evacuees.

The first specially designated shelter was finally opened on April 7 by the city administration. As shown in Figure 14, they transformed an unused nursery school site as an alternative shelter for PFND (Aoki, 2011). An additional four specially designated shelters were also opened two weeks following the first one. One of this is the Shunpo-en special nursing home for the elderly which is shown in Figure 14. There were 60 elderly residents being housed in the Shunpo-en nursing home, including about one hundred general evacuees and some PFND from the surrounding neighborhood which were cared for by the nursing home staff. However, the director of the nursing home expressed concern about running a specially designated shelter for a prolonged period due to the financial burden it would entail.

This would have been not the case had the Kesennuma city conducted pre-planning for the specially designated shelters for PFND. In the case of Kesennuma city, it was only learned later in April that officially designating the shelters for PFND would allow additional financial support on top of the regular service hours as prescribed by long-term care insurance scheme. Similar to Ishinomaki city, the Kesennuma city

Shunpoen Nursing Home Shelter (April 7, 2011)

Ochiai Nursery School Shelter
(http://www.toshinkai.or.jp/image/C8EFBAD2C3CFC7C9B8AFCAF3B9F0.pdf)

Figure 14. Specially designated shelters at Shunpo-en Special Nursing Home (Top) and Ochiai Nursery School (Bottom).

administrators also lacked of awareness regarding the legal framework (i.e., Disaster Relief Act special service provision clause) that would ease tremendous financial burden which the city and/or the designated shelters like Shunpo-en home might have had to bear otherwise.

Based on the above cases, aside from Sendai city, the other municipalities were not able to conduct pre-planning and make arrangements to prepare specially designated shelter operations with social service providers. Two main reasons were learned to explain why Ishinomaki and Kesennuma cities took nearly three weeks post-disaster to formally designate said shelters. First, they thought that their facilities would not have met the standards, as stated in the pre-disaster planning manuals, for specially designated shelters. Second, due to lack of pre-planning, many local officials were unaware of the legal provisions under the Disaster Relief Act specifically to provide additional resources for the sheltering needs of people with functional needs. In spite of these reasons, with the help of local service providers, these municipalities were still able to provide and operate alternative shelter that met the functional needs of the PFND. Still, if the operation of the functional-needs shelters were officially declared earlier by the local municipalities, these municipalities would have been eligible for additional resources at the onset of the event both from the national and prefectural governments. To address the issues discussed here, there is a need to develop a more detailed guideline to assist local administrators in pre-planning specially designated shelters and temporary housing operation for PFND.

Utilizing Personal Information of PFND

The problem of visibility for some types of PFND became apparent in the aftermath of the March 11 disaster. This was specially the case for People With Disabilities (PWD) who did not go to the general population shelters for assistance. The PWD felt that these shelters were ill-equipped to respond to their functional needs. As a result, they hardly visible in the shelters and their communities, and in effect they were unseen by the local government administrators.

Another reason for their invisibility can be attributed to the reluctance of many local government administrators to release to or share their PFND registry for fear of breaking the Personal Information Protection Bylaw. However, the Bylaw explicitly states that there are exceptional conditions allowing the sharing of personal information. Under the terms of which, the onset of disaster is clearly one of these exceptional conditions wherein the local government may share the personal information of the PFND with other organizations, including self-help organizations intent to locate and check on the current situations of PWD.

While many local governments were hindered by their lack of understanding of the Bylaw, Minamisoma city officials in fact released this information to a local NGO. Meanwhile in Higashimatsushima, they found a workaround to allow members of the Japan Disability Forum (JDF) and other groups who worked on

behalf of disabled persons, by letting them accompany public health nurses during their home visits. JDF reported that they were able to visit and meet 1,386 persons with disabilities as of June, 2011. However, there are about 53,511 PWD registered in the areas devastated by the March 11 disaster which means that JDF barely scratched the surface and were only able to check on 2.6% of the population. Similarly, researchers and other groups that advocate for the well-being of PWD were unable to determine the condition and grasp the situation of a large number of the PWD affected by the March event.

While there may have been other municipalities that attempted or employed similar approaches to that of Ishinomaki and Kesennuma cities, it appeared that most of the municipalities in the affected areas had not attempted to initiate efforts to reach out to the PWD population. As a consequence, local officials were unaware of the needs of the PWD, especially persons having mental and development disability which is less apparent than those with physical disability. Gathering from this issue, better explanation on how personal information of PFND in times of disaster may be utilized so as to educate local government administrators is needed to address this issue.

CONCLUSION

This paper focused on the achievements and newfound challenges before and after the March 11 Great East Japan Earthquake and Tsunami Disaster. The first part dealt with the recent achievements and developments on counter-disaster measures for PFNDs in Japan. One of the most important achievements, which were realized since 2004, was the publication of the report on preparedness procedures for people with functional needs. It provided a guideline for local governments to create a master plan for assisting PFND, which focused on individualized evacuation/sheltering assistance for PFND. The case of the Kobe mapping project also suggested a standardized method of identifying and locating persons with high level of vulnerability. This was done by employing a comprehensive analysis of the person and their environment by using the person-in-environment model of assessing vulnerability.

According to the FDMA survey, majority of the municipalities all over Japan were able to complete their master plan for assisting PFND and efforts are underway to compiling database of PFND registry as well as assigning local helpers to assist specific individuals during emergency evacuation. However, despite efforts on the part of the local and national government, newfound challenges were revealed from the aftermath of the March 11 earthquake.

The second part of this paper discussed the three major challenges in preparedness, response and relief measures for PFND, which were revealed from the initial field visits to the affected areas in March and April. Some solutions were also proposed to address these issues. First, the challenge in identifying people at risk by re-thinking how hazard is estimated was presented. The March 11 disaster gave an important lesson

that the hazard estimation method framework currently utilized may be erroneous requiring a shift from *maximum probable event* to *maximum possible event* framework. To achieve this, the reflexive scientization proposed by Beck (1992) needs to be realized. The second challenge discussed was related to operating specially designated shelters for PFND. And the third challenge introduced was concerned with utilizing personal information on PFND in times of disaster. The second and third challenges were rooted in the lack of pre-planning and understanding by the local administrators of the legal framework relating to operating specially designated shelters and utilizing personal information on PFND. To address these two challenges, further elaboration and education on these issues was recommended.

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