Evacuation and Sheltering Assistance Planning for Special Needs Population: Kobe GIS-Mapping Project of People with Special Needs in Times of Disasters

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Abstract

This paper reports the results from the 2008 Kobe GIS-Mapping project of people with special needs in times of disasters, which demonstrates the use of GIS for mapping special needs populations in order to facilitate community-based evacuation and sheltering assistance planning. In response to a national government request, Kobe city administration collated separate social service recipient databases, resulting in an integrated database involving one hundred and twenty thousand individuals who were considered being potentially vulnerable in times of disaster. The database identified 4,329 people with physical disabilities in Hyogo Ward. The 2008 project geocoded and mapped them on land slide, flood and tsunami hazard layers. 914 individuals were found residing in hazardous areas. These individuals were visited by interviewers and 612 or 67% responded to a structured questionnaire which measured demographics (i.e., age and gender), levels of disability, social isolation, housing fragility, and physical immobility. A social vulnerability score was then calculated as a function of these five variables for each respondent. As a result, 17% of those who responded were found the most vulnerable and requiring priority assistance at times of disaster. Furthermore, a social vulnerability weighted kernel density map of people with special needs was created. The weighted kernel density map indicated which particular areas would require more man power for assisting a special needs population for evacuation and sheltering. After 2011 Great East Japan Earthquake , it became evident that recent developments in GIS-based preparedness measures had been uncritically relying on the assumption that *maximum probable event* (*MP_rE*) would occur. In reality, *maximum possible event* (*MP_oE*) occurred in Tohoku regions. Fundamentally re-thinking entire hazard estimation process from MP_rE to MP_oE framework was discussed in the end.

Key words: persons with special needs in times of disaster, hazard vulnerability, GIS mapping of social vulnerability, person-in-environment model, maximum probable event, maximum possible event

1. Introduction and Background

The issue of special needs population gained high attention after 2004 when a series of natural disasters hit the Japanese Archipelago. Those included July Niigata-Fukushima flood, October typhoon 23 and October Niigata Chuetsu earthquake disasters, wherein notably more than 60% of the victims were over the age of 65. As a response to these tragedies, Japan's Cabinet Office established a committee on "Communicating Disaster Information and Evacuation and Sheltering Assistance for the Elderly and Other Population during Heavy meteorological and Other Disasters." The committee published the first edition of the "Evacuation/Sheltering Assistance Guideline for People with Special Needs in Times of Disasters" in the following March 2005. After the guideline publication, the term *saigaiji-*

youengosha or People with Special Needs in Times of Disasters (PSND) was popularized in place of *saigai-jakusha* or Disaster Vulnerable Population. PSND is defined as "a person who is able to function daily, whereby living independently given the proper resources and services when necessary". In normal time, institutionalized long-term care services for the elderly and/or for people with disabilities provide a safety net so that their special needs are met for living independent lives. However, when a disaster strikes, it becomes extremely difficult for institutionalized cares/supports to reach people in need for a prolonged period, causing their vulnerabilities to manifest. The emergence of new terminology, PSND, reflects a shift on the side of society from viewing difficulties experienced by the target population as being intrinsic to themselves to viewing ones as products of social interactions that fail to meet special needs in time of disaster (Tatsuki and Comafay, 2010; Comafay, 2011). Thus, the shift in societal view led a new set of questions, who should take care of people in need when the institutionalized care/support systems break down in time of disaster?

Following another series of heavy rainfall, flood and land slide disasters in the year 2005, another Cabinet Office committee conducted field research of the 2005 meteorological disaster sites and revised the evacuation and sheltering assistance guideline in March 2006. The 2006 guideline emphasized 1) establishing a special team in each municipal government that was in charge of coordinating assistance to the target population, 2) encouraging the information sharing of special needs population within the local government and, if possible, with local community organizations such as neighborhood associations and community emergency and response team, and 3) planning individualized evacuation and sheltering procedures for each PSND.

In the following fiscal year 2006, the committee on PSND continued to work on more detailed procedures and workflows in order to collect and share information on PSND and to make individualized evacuation and sheltering assistance plans. In March 2007, the committee published the "Report on Preparedness Procedures for PSND." The 2007 report emphasized the establishment of a system to assist PSND by facilitating cooperation between the local/municipal government disaster management department and its health and welfare department. The role of the disaster management department is to provide local hazard information, while the health and welfare department provides information on potential vulnerabilities within the target population. The 2007 report encouraged the use of map where potential vulnerable individuals such as frail elderly and people with disabilities (PWD) are projected onto multiple hazard layers such as flood, landslide and seismicity. The map can help identify who are at more risk because of their functional needs (Kailes and Enders, 2007) as well as of their geographic locations.

Since the publication of the 2006 guideline and the 2007 report, the Fire and Disaster Management Agency (FDMA) has requested every municipality in the country to formulate its own master plan that directs policy formation on PSND assistance, to identify potential target groups, to clarify ways to collect and share their personal information. Based on the master plan, municipalities have been further encouraged to start project planning to assign local resident helpers to each individual PSND in time of evacuation. According to the survey conducted by FDMA, as of April 1, 2011, 1,262 out of 1622 municipalities (76.8%) finished formulating PSND assistance master plan and additional 349 municipalities (21.2%) were expected to finish within one year. Similarly, 864 (52.6%) municipalities reported that they have finished creating and have been updating the PSND registry. 684 (41.5%) municipalities said that they were currently in the process of making the registries. Municipalities have been working hard even on assigning local residents/helpers to each PSND for evacuation, much more time consuming process. 361 (22.0%) reported that they

have completed the assignment, 998 (60.7%) in the process, and 285 (17.3%) not yet initiated (FDMA, 2011).

2. Mapping PSNDs as an Effective Counter-Disaster Measure

2.1 Use of Maps to assist PSNDs during the 2007 Noto Peninsula Earthquake

At around the time when the 2007 report was about to be released, the Noto Peninsula earthquake occurred in March 25, 2007. A study was conducted by Comafay, Tatsuki and associates (2008) on to find out how PSND, especially the elderly population, was responded to during the Noto Peninsula Earthquake from the framework of the 2007 report. A series of workshop was conducted with those who provided assistance, this included representatives from the public health department of Wajima city, the private long-term care service providers and local community organizations. The results revealed that, as shown in figure 1, during the first 10 hours after the earthquake the local community organizations were first to respond to the most urgent needs of PSND. Meanwhile, the government organization was able to provide formal services 100 hours after the disaster impact. Finally, sustained service delivery from the formal organizations increased as those coming from the community organizations decreased after the first ten hours.

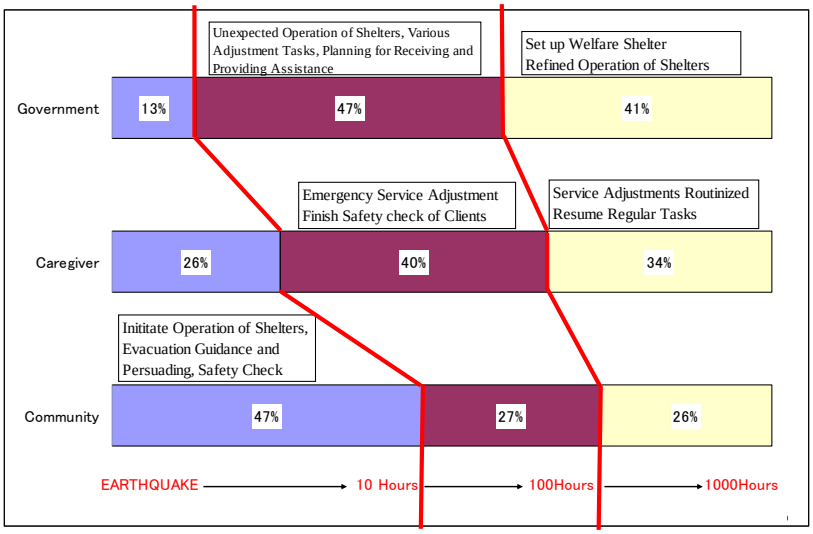

Fig 1: Responses to PSND during the Noto Peninsula Earthquake by Local Community, Long-term Care Providers and Health Service Office

It was learned that community-based help for the elderly had been predesigned and cultivated in Monzen area during normal times by indigenous community-based workers called *minseiiin*[1] or commissioned welfare volunteers who were active in building elderly-person-watch networks. The percentage of people over the age of 65 in Wajima areas[2] is very high at 35.2 percent. A way before the 2007 earthquake, the local health and welfare offices in then township of Monzen (currently a part of Wajima city) launched an initiative to build elderly-persons-watch networks with the *minnseiiin*. Even before that, right after the 1995 Great Hanshin-Awaji earthquake, the local health office in Monzen town which was one of the most

[1] A *minseiiin* or commissioned welfare volunteer is a community-based volunteer friendly visitor commissioned by the Ministry of Health and Welfare to assist and maintain regular watch over persons with special needs, especially the elderly, living in that district.
[2] In February 1, 2006, just a year before the Noto Peninsula Earthquake, Monzen town was merged with the former city of Wajima city to create a new Wajima city.

affected areas during the Noto Peninsula earthquake, started commissioning the *minseiiin* to create a welfare-map plotting the exact location of persons with special needs who require constant supervision in their respective area of jurisdiction. As shown in figure 2, welfare maps are created based on existing residential maps. Buildings with households are then marked with colors according to 4 categories: a)pink for bed-ridden persons; b) yellow for elderly persons living alone; c) green for elderly only households (elderly couples); d) blue for household with disabled persons. Along with the *minseiiin*, local volunteers would conduct safety checks and provide services such as delivering food or helping with their groceries to name a few.

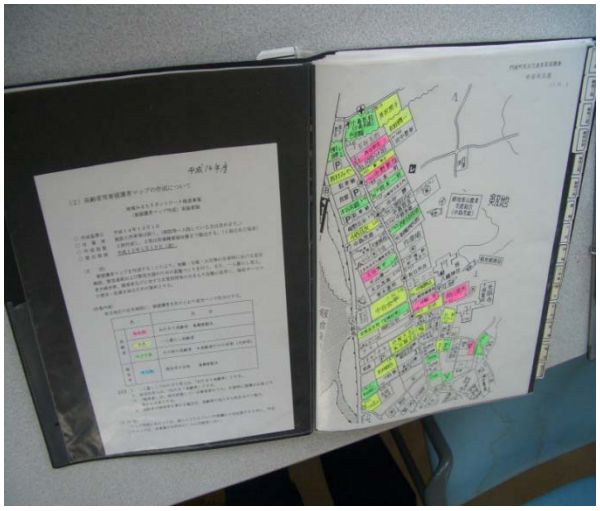

Fig 2: A picture of "welfare map" that are currently used by minseiiins in Monzen area, Wajima city.

The paper-based welfare map was very crucial because according to the *minseiiin*, although they did not need the actual map during the emergency evacuation, making the maps helped them be better familiarized with the neighborhood. Therefore immediately after the earthquake they were able to identify the persons with the most urgent needs and not only that since they had a mental map of the area they also knew their exact locations. The actual map was later used in guiding the volunteers and health nurses and non-locals who were not familiar with the area.

The above study has provided empirical evidence that community actors, being geographically accessible are the most reliable service providers during the first 10 hours after a disaster strikes. The experience of the service providers during the Noto Peninsula earthquake also demonstrated the importance of identifying during normal times the PSND with the most immediate need for assistance. As well as, providing insights on how mapping the location of disaster vulnerable members of the community would be useful for identifying actual locations of those who require immediate assistance. The familiarity of the people who provided assistance and services, mainly the *minseiiin* and the local volunteers, was developed by the creation of paper maps to identify the location and condition of the special needs population.

2.2 Kobe PSND Mapping Project

Tatsuki and Comafay (2010) reported the 2008 Kobe PSND Mapping Project, which was characterized by a combined use of GIS and the social survey in order to assess overall hazard vulnerability of PSNDs. In response to the FDMA request as explained in the above, 1.5-million-resided Kobe city administration collated separate social service recipient databases,

resulting in an integrated registry involving one hundred and twenty thousand individuals who were considered being potentially vulnerable in time of disaster. The registry database identified 4,329 people with physical disabilities in 107- thousand-resided Hyogo Ward. The 2008 project geocoded and mapped them on land slide, flood and tsunami hazard layers. 914 individuals were found residing in hazardous areas (see figure 3).

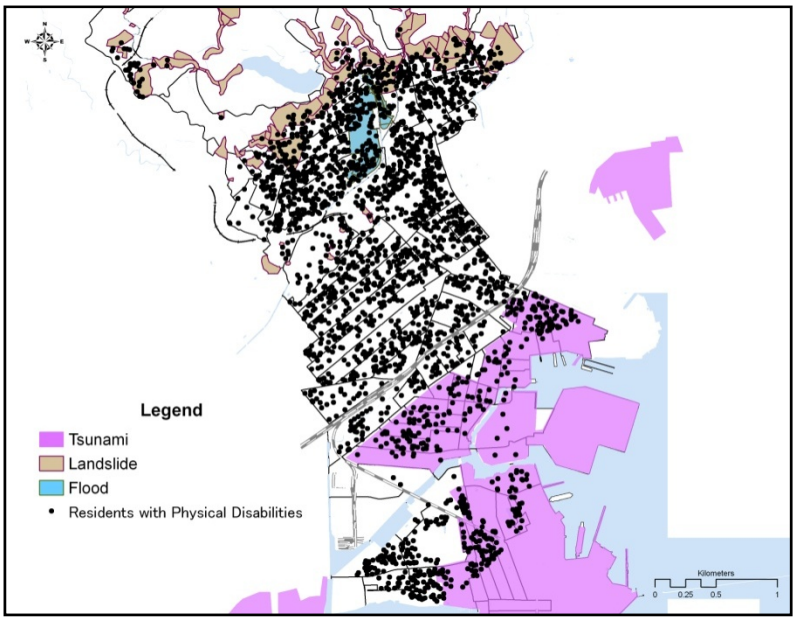

Fig 3: Persons with disabilities living in Kobe's Hyogo ward (N= 4,411)

These 914 individuals were then visited by interviewers and 612 or 67% responded to a structured questionnaire which measured those six variables as demographics, physical impairment, physical immobility, responsiveness of social environment (social capital), social isolation and housing fragility (see figure 4). The demographic, physical impairment and physical immobility variables measured a *person* factor, social capital and housing gragility an *environment* factor, and social isolation a *person-by-environment* factor.

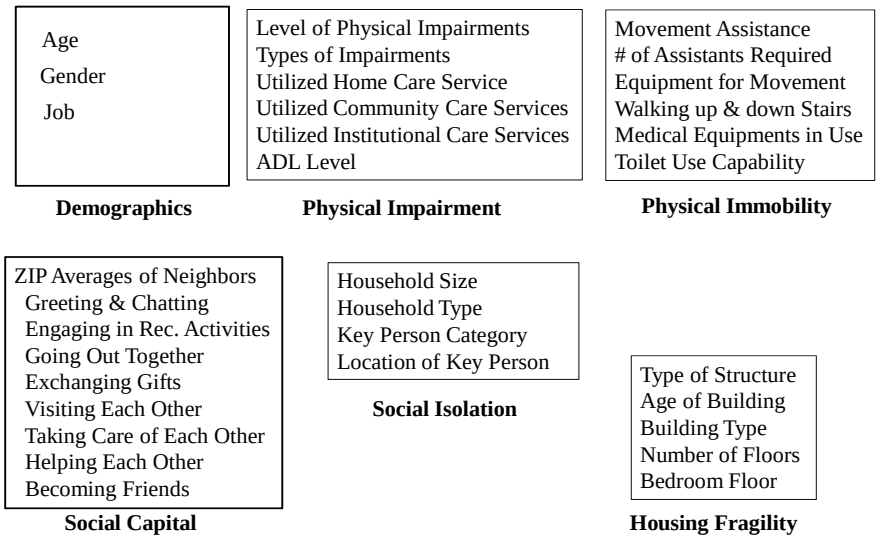

Fig 4: Variables Measured/Obtained in the Study

The 2008 project was based on the person-in-environment 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) as illustrated by figure 5.

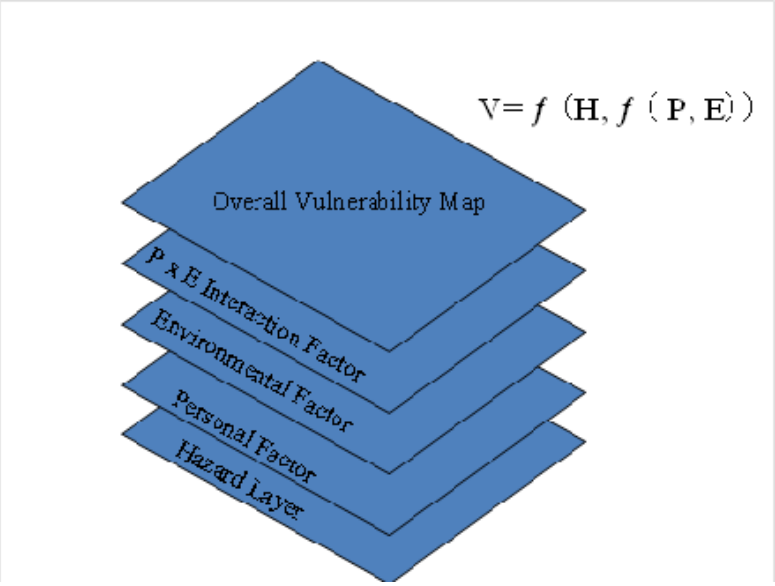

Fig 5: Person-in-Environment model of mapping hazard vulnerability

Based on the model, respondents' scores for each factor/component were calculated from social survey results and they were plotted as shown in figure 6.

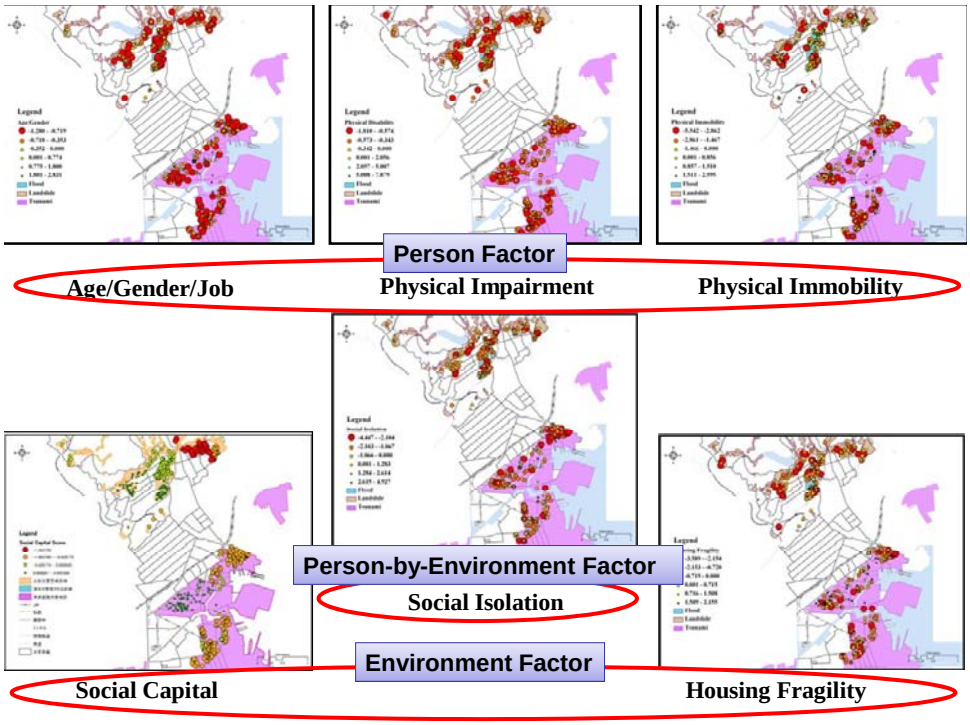

Fig 6: Componet vulnerability scores mapped on to hazard layers

Finally an overall vulnerability score was then calculated as a function of hazards and the six variables for each respondent. As a result, 17% of those who responded were found the most vulnerable and requiring priority assistance in time of disaster (see figure 7).

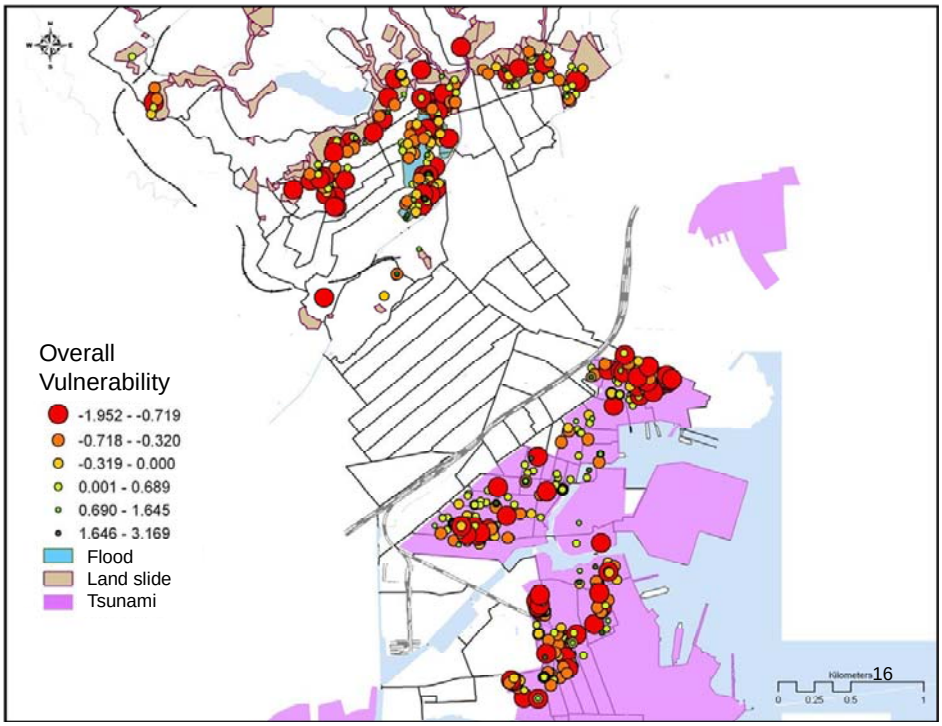

Figure 7: Overall vulnerability scores mapped on to hazard layers

Furthermore, a social vulnerability weighted kernel density map of people with special needs was created (see figure 8). This map indicated which particular areas require more human resources for assisting a special needs population for evacuation and sheltering. The project product maps helped representatives from special needs groups, community emergency response teams, community social services, and emergency management centers initiate evacuation and sheltering assistance planning in the project areas.

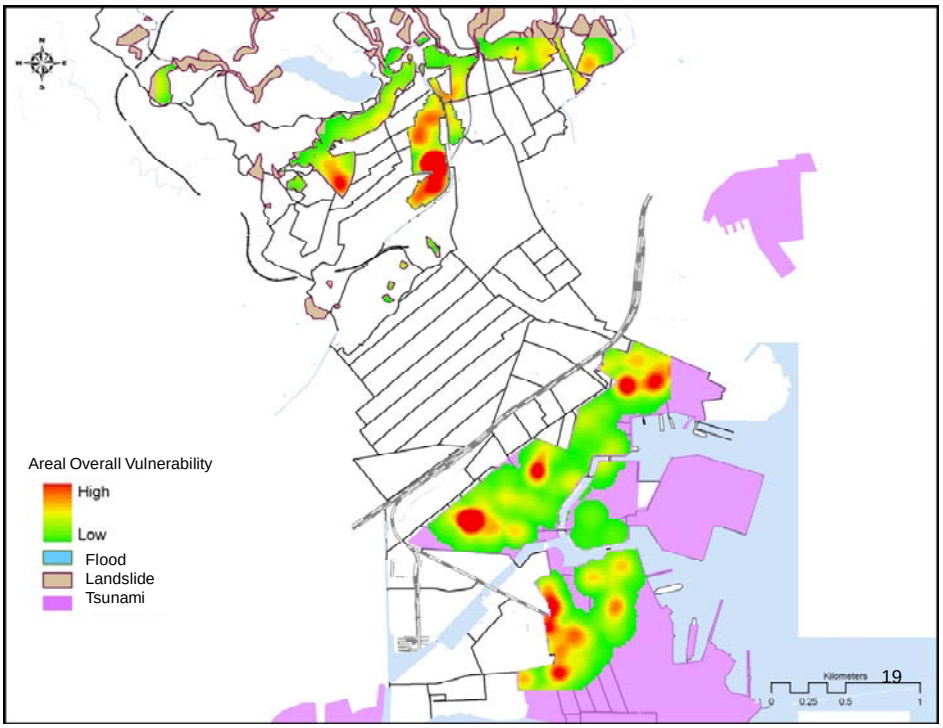

Figure 8: PSND kernel density estimation weighted by overall vulnerability index

The 2008 Kobe PSND mapping project was an attempt that aimed to provide a standardized method using individual social vulnerability mapping as analysis tool to identify more

comprehensively the risks that could affect a given community. This could help different stake holders, special needs groups, community emergency response teams, community social services, and emergency management centers initiate evacuation and sheltering assistance planning in high risk communities.

3. Toward a Refinement of Person-in-Environment Model: Maximum Probable to Maximum Possible Event Framework

Despite recent developments of PSND counter-disaster measures as illustrated in the abvoe, serious problems confronted municipalities, communities, PSNDs and their families at the onset of March 11 Great East Japan Earthquake Disaster. Three reconnaissance missions conducted by the author team in March and April identified several challenges on counter-disaster measures for PSNDs. One of these challenges demanded re-thinking ”correct” hazard estimates in the person-in-environment model of hazard vulnerability (Tatsuki, 2011).

Recent developments in preparedness measures for PSND in Japan have been uncritically relying on the assumption that hazard maps represent “correct” estimates of future hazardous events. As figure 9 in the below illustrates, this turned out to be a horribly wrong assumption. Hazard maps were created according to *maximum probable event* (MP_rE) framework. In reality, however, *maximum possible event* (MP_oE) has occurred in Tohoku regions. This has tremendous implications for fundamentally re-thinking entire hazard estimation process from MP_rE to MP_oE framework.

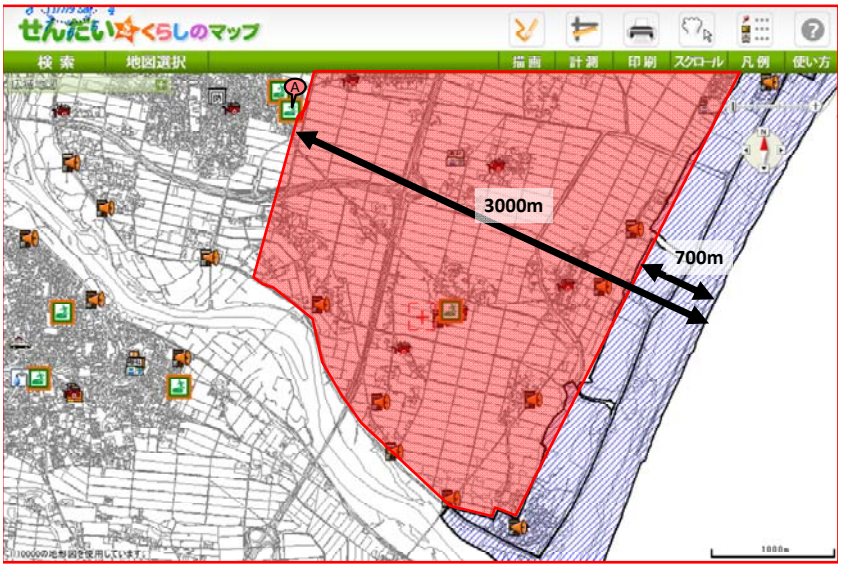

Fig 9: Tsunami hazard map and actual inundation east of Rokugo Junior high school, Wakabayashi ward, Sendai city

In the previous section, the person-in-environment model of hazard vulnerability (V) was introduced as a function of hazard (H), person (P) and environment (E) factors or V = f(H, f(P, E)). In practice, hazard factor was estimated by *maximum probable event* framework and therefore the model could be represented as V = $f(MP_rE, f(\mathrm{P}, \mathrm{E}))$. The challenge here is to replace *maximum probable event* hazard estimate with an alternative hazard estimate by incorporating *maximum possible event* framework. The modified person-in-environment model will therefore be represented as V = $f(MP_oE, f(\mathrm{P}, \mathrm{E}))$.

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