Resilient Cities: Plan Evaluation for Floods

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ABSTRACT

A local hazard mitigation plan (LHMP) is the fundamental base to protect individual properties and citizens' lives from the local chronic and unexpected, overwhelming natural disasters. Each community prepares their own LHMP based on their specific features and conditions since regions are different by geographical features, social norms, and cultural backgrounds. Of those differences, this study focuses on how the developed countries in hazard mitigation consist of LHMP and which part of the plan is strong or weak. This research presents comparisons for the LHMPs communities in three different countries: USA, Japan, and Korea. Indicators used in the research are very common ones that can be applied to the three countries. The result shows us an opportunity not to look at our LHMP as demonstrative administration, but to make it user friendly. As a result, it is strongly believed that more common indicators should be developed into LHMP and the compromise between bottom-up (PPP) and top-down (LHMP) should be discovered.

1. INTRODUCTION

Natural disaster preparedness is an emerging issue all around the world, specifically due to the recent climate change. The magnitude of damage from natural disasters—landslides, floods, and earthquakes—is growing and is even worse than the past. Based on statistics from the United Nations International Strategy for Disaster Reduction (UNISDR), during a period from 1970–2005, the major threat of natural disasters in the world was flooding (30.7%), and the second was a storm (20.6% [UNISDR, 2014]). During the last few decades, there have been such natural disasters as tsunamis, floods, earthquakes, and even man-made disasters, like nuclear power plant explosions, from Southeast Asia to North America. Therefore, much research has been conducted for the structural measurement of community resilience to overcome those impediments. It is, however, not possible that all natural disasters and natural-related disasters can be controlled. There has been much research on the community capacity of natural hazards to understand community capacity and elasticity in Japan (Matsuda & Okada, 2006). That would be one of the appropriate approaches to live with natural hazards. Also, many research projects have estimated flood flow volume and predicted time covered by overflow water in Kumamoto, Japan (Yamada, Kakimoto, Yamamoto, Fujimi, & Tanaka, 2011). Likewise, there have been many technical or structural approaches to deal with natural hazards. Unfortunately, however, little research has been done in a plan quality evaluation in Japan. In Korea, there are gradually emerging climate-related disasters and related losses as well. For example, Umyeon Mountain landslide in Seoul caused dozens of casualties even

though the amount of rainfall was the 10-year return period. The rate of urban flash floods in metropolitan areas is increasing. Many thought an urban core area would be safe due to its well-organized urban functions, such as retention, storm surge management, and even administrative function; however, the sense of false safety sometimes makes people lose their sense of security for uncertain natural disasters and man-made disasters. For the above reasons, there are more compromise methods emerging to be a resilient community. It is easy to find this research paradigm movement from structural mitigation to nonstructural in the current studies. For example, there is a Local Government Self-Assessment Tool for disaster resilience on the UNISDR web site. In addition, many North American universities have been developing hazard mitigation plan quality protocols. Specifically, flood risk management in a local government has mainly been done by a local hazard mitigation plan, a fundamental commitment to protect citizens and properties. With these efforts, this study tries to show which categories or components are needed and practical to improve hazard mitigation plans by comparing developed and developing countries and also what we have to take into account for local government self-assessments under a different political system. Fundamentally, this research tends to discover common elements (indicators) among countries that have different cultural basis with regard to the evaluation for a Local Hazard Mitigation Plan (LHMP). This paper first presents how to select the study site for comparison and the data collection method in order to assess LHMP in each country. Next, it introduces a plan quality protocol from literature reviews. Then, it explains the categories and indicators used in the study. Finally,

the paper compares the results of each community LHMP and provides recommendations and implications.

2. SITE SELECTION AND DATA COLLECTION

The previous work of our research team was a longitudinal study comparing Kumamoto City's LHMPs from 2001 and 2012. Basically, this research was interested in the LHMP of Kumamoto City and how well the plan covered the practical, fundamental issues to protect citizens and reduce potential damage costs, such as property owners at risk, future development activities within the floodplain, and financial flow for the effort to decrease the reverse effect from the natural hazards. Naturally, Kumamoto City was chosen as the study site for this study. There are three criteria to choose the study site to compare the LHMP of Kumamoto City with other countries' LHMPs. First, the other sites should have similar geographical features, such as longitude and latitude, annual rainfall, and temperature. All sites should, relatively, have the same condition with respect to environmental perspectives being compared. Second, the sites need to have a major threat of natural hazards. All three study sites are facing the sea. Also, it is said that flooding is the major threat in the three local government web sites. Third, there should be a developing country and a developed country in hazard prevention to better understand the current situation of Kumamoto City. Therefore, it could know that what part of the category or indicator would be reinforced in order to be a resilient city. Table 1 displays the characteristics of each city.

The mean precipitation of Kumamoto is higher than the others, but all three study sites are faced with flooding as a major threat based on their official web site information. Furthermore, the study sites are affected by maritime climate. Three local governments have had a form of a Local Hazard Mitigation Plan (LHMP), although the name is sometimes different. These geographical features can be found in the study sites. Lastly, the size of cities should be taken into account. Cities with a relatively similar population were selected for this research.

Even though the population difference between the biggest city, Kumamoto, and the smallest, Pohang, is approximately 200,000, those cities were selected due to the fact that cities that have more than 500,000 citizens would have good enough administrative powers to construct or build local plans.

Each LHMP can be downloaded from the cities' official web sites: Baltimore's final 2013 version of Disaster Preparedness and Planning Project (DP3) and Kumamoto City's 2012 Kumamoto City Regional

Table 1. The characteristics of study cities

	Annual Rainfall (mm)	Annual Temperature (°C)	Major Threat	LHMP	Feature
Kumamoto	1985.9	22	Flood	O	Port
Baltimore	1152	14.2	Flood	O	Port
Pohang	1100	13	Flood	O	Port

Source by Korea & Japan Meteorological Agency and Wikipedia

Table 2. The approximate population in the cities

City	Population
Kumamoto	733,885 (Kumamoto City, as of 2013)
Baltimore	621,342 (USCensus, as of 2012)
Pohang	523,489 (Pohang City, as of 2013)

Hazard Prevention Plan (KCRHPP). Pohang City, Korea's plan is not available online—we contacted the emergency department of Pohang City to receive the information for their Safety Management Plan (SMP) in 2013.

3. LITERATURE REVIEW

For the last several decades, there have been tremendous efforts to improve implementation and application for natural hazards protection. Mostly, these efforts have focused on structural implementations, such as channelization, levees, seawalls, and other engineering efforts to overcome negative aspects, and to expand human activities upon potential hazardous areas. However, too much dependence on structural implementation could increase collateral damage in hazardous areas when actual events occur. Since the 1970s, many hazard scholars have argued that structural and nonstructural implementations should be balanced when local emergency agents consider natural hazard mitigation at a local level and regulate development activity in hazardous areas (Berke, 1998; Burby, 1998; Burby, Deyle, Godschalk, & Olshansky, 2000; Nelson & French, 2002; Zhang, 2010). In addition, scholars have asserted that stand-alone mitigation plans should be integrated with a local comprehensive plan (Deyle & Smith, 1998; Godschalk, Beatly, Berke, Brower, & Kaiser, 1999). That is because most disaster losses result from localized natural disasters. Of course, there are the catastrophic disasters, such as the Great Japan Earthquake, which make people pay attention to risk perception and preparedness for future disasters. However, we need to focus more on the localized issues, such as a LHMP, to minimize or mitigate localized disasters. These localized disasters, of course, are not limited to one jurisdiction but transjurisdictions and multiparty issues (Brody, 2003c). Yang et al. (2009) found that community businesses in environmental disasters are specifically vulnerable not only physically, such as lifelines or infrastructures, but also nonphysically, such as capital mobility, business size, market

devastation. Therefore, all efforts to mitigate adverse impacts from natural hazards should set forth at a local level to be resilient communities. In a sense, there should be higher governmental entities to mix this local level of efforts up in order to cope with the characteristics of natural hazards, such as transboundaries. To do this, it should begin with a LHMP, which is the very commitment to protect its localities and their properties. Through the 1960s and 1970s in the US, many studies began to evaluate the plan quality (Hill, 1968). Hill studied alternative plans for public investments, particularly water resources development, so that plans would better serve the set of purposes. He also argued that a rational planning process is the best to maximize the expected attainment of a set of given resources, using a traditional cost-benefit analysis by means of the evaluation plans. Ultimately, he compared the plan with an alternative plan for public investment through a goals-achievement matrix. However, it did not focus on the plan quality itself, but more likely a specific project due to the character of the cost-benefit analysis; whereas, Alterman and Hill (1978) studied the relationship between planning and implementation, or plans and their performance, through a case study which compared the outline plan with the detailed plan in a study area by using building permits accordance.

However, it is necessary for plans to be evaluated gradually since disaster damage cost is growing. Baer (1997) may be the one who established the hard foundation for plan quality evaluation with indicators and criteria under some categories. He proposed that there were around 60 indicators to assess general plan quality under eight categories. He also insisted that a plan should be explicitly explained about ideas for a city to aim at, rationality, and that plans should have readability and attractively laid out and easy to read by using graphics and maps. Based on Baer's contribution, many empirical and theoretical studies have been conducted. Of those, Berke, Godschalk, and Kaiser (2006) developed a plan quality evaluation protocol on the basis of fact, goal (objective), and action. The protocol devised to grade plans based on scoring either 0 (not identified), 1 (identified, but slightly mentioned and vague), or 2 (identified, with detailed information and clear), with indicators under three categories. By doing so, plan quality could be quantified and could possibly be compared with other cities or municipalities, not on a project base but the whole plan itself. With their efforts, the protocol has been used in many parts of planning fields, such as ecosystem management (Brody, 2003b), sustainable development (Berke & Conroy, 2000), plan quality associated with natural hazard emergency (Brody, 2003a), planning theories with environmental plan quality (Tang & Brody, 2008), a

local plan quality (Berke, Backhurst et al., 2006), local environmental planning by evaluating comprehensive plan for each jurisdiction occupied by a significant wetland permit cluster (Brody & Highfield, 2005), measuring tsunami planning capacity (Tang, Lindell, Prater, & Brody, 2008), coastal zone land use planning capacity (Tang, 2008), climate change action plan quality (Tang, Brody, Quinn, Chang, & Wei, 2010), and evaluating local land use plans' Environmental Impact Review (Tang, Bright, and Brody, 2008). Actually, there are more than the above, such as wild fire plan, landslide plan, and so on. Indeed, Berke, Godschalk, and Kaiser (2006) have contributed to the knowledge of plan quality evaluation quality. The next section will explain how to be evaluated and which common indicators be used for the three different countries' plan quality comparison.

4. RESEARCH METHOD

As mentioned the above, the main purpose of this study is to compare of plan quality for three different countries, through a best management plan (BMP). Ultimately, the comparison of these plans could provide the strong commitment with local officials related to emergency and elected officials who might be less interested in natural hazard issues for their next term. This plan quality evaluation method, indeed, would not be perfectly credible to all three countries. However, it would be a good starting point to compare other countries' LHMP to find out the right way to the developing country in natural disaster management, like Korea, even though the three countries do not share the same cultural base.

The indicators used in this research total 18. Previous research through the literature review found many possible indicators, around 30 to 60. However, these are mostly planning tools, such as setback, subdivision, zoning, or conformity/nonconformity. Some of these are commonly used in other countries but some of them are not. Indicators are selected based upon the fact with which anyone can agree. The indicators under the three categories follow.

Table 3. Indicators used under three categories

FACT	GOAL	ACTION
Population	Development within hazardous areas	Check-up system
The vulnerable	Property protection	Time-schedule for a certain implementation
Singlehead house	Natural resource	Good relationship with local gov. and localities
No. of critical facilities	Local fiscal loss	
No. private facilities	Sustainable comm.	
Median income	Public facility	
Below poverty line	Promote awareness	
Shelter & emergency plan	Communication & coordination	

4.1. Fact

As seen in past research, finding facts in a plan can be a starting point of the research. The stronger factual basis a community has, the more sustainable a community can be. Fundamentally, the fact basis components will contain the hazardous location and extent of hazard damage; environmentally sensitive areas; a map of hazard magnitude; exposed populations, specifically the children, elderly, and disabled; structural loss estimates; evacuation route; and clearance time. It would be highly possible for economically vulnerable groups and the disabled to be exposed to natural threats. Furthermore, it is critical that there are technical skills, such as Geographical Information System (GIS) and experienced staff members (manpower), in a local area.

4.1.1. Population/Population Growth

Population is the critical factor in a hazard mitigation plan. It is fundamental to know exposed populations in a hazardous area. Additionally, larger population jurisdiction may have more financial, manpower, and material opportunity to reduce a local hazard. Apparently, it is critical that the population growth prediction within a local boundary be for the right population cohort. Through this fact finding, a local government will properly set up the goals/objective and prepare for the local hazardous area as well as for future local hazard mitigation plan and even comprehensive plan.

4.1.2. Children, Elderly, and Disabled

Specifically, children, and the elderly groups are extremely vulnerable to natural threats. In Japan, an aging society began a few decades ago. Specifically, young people have rapidly left suburban areas, such as a mountainous district, less infrastructural areas, and industrial areas. For instance, there are hundreds of people living around Mount Aso. They are all relatively exposed to landslides during rapid heavy raining. Two years ago, 23 people died and two people were missing from the heavy rain. This is, of course, because of rapid heavy rain in a short time. A local government should know where the vulnerable groups mostly resided. As is known, the above three groups are less mobile than other groups. Therefore, it is necessarily to know how many and in which areas children and the elderly reside. This can be drawn from population/population growth in a local areas. With this information, a local government can better recognize where vulnerable population cohorts live and prepare for proper techniques or legal obligations for the dependents. A local government can provide proper education programs for the people who take care of the dependents.

4.1.3. Single-Headed Household

A single-headed family could suffer financial difficulties. They may have less time and interest in hazard issues when compared to others, simply because they have to work harder to make money. Additionally, they tend to be less-educated, thus, they may be less concerned by natural hazards and environmental issues in their community. However, this indicator can be too sensitive to expose to the public, so this sensitive information should be dealt with carefully.

4.1.4. Number of Local Critical Facilities

The location of local critical facilities, such as police, fire stations, hospitals, power lines/plant, and water and sewage systems, is important. It is highly recommended to check current locations of the critical facilities and their capacities by using a local hazard map so that local governments can precisely prepare for local capacity and alternative plans when hazards occur. This information should be shared with the locals, thus the locals can get help anytime they need it by the local public notice channels.

4.1.5. Number of Private Structures

It is important to estimate how many private structures are exposed to current local hazard threats. Through this, it can be possible to estimate potential private property loss and predict shelter demands within a local area.

4.1.6. Median Household Income

It is important to recognize the local median income level. This is because median household income would be used to determine the local economy index rather than the national level. A higher level of community would better prepare for local hazards than that of a lower level. Local government financial soundness would have a positive effect on the local mitigation plan. It could be highly correlated with local education levels based on former research.

4.1.7. Households Below Median Income/ Households Below Poverty Line

This is related to the above indicator. However, it is necessary in order to find out how much the population rate is exposed to the vulnerability of threats. Many previous studies found that the financial vulnerability of a household is related to other social statuses, which makes households exposed to not only economically vulnerability but also a physically one as a social component.

4.1.8. Emergency Plan and Shelter

An emergency plan can be used to include clearance time and shelter capacity information. It is necessary that emergency staff members cope with hazards, emergency shelter demands, and current

capacity data. This is also related to the regular plan updating and local population growth, thus, it makes sure of potential shelter demands and capacities.

4.2. Goals and Objectives

Goals/objectives evaluate how much the hazard mitigation plans have a commitment in order for an area to reduce property loss and local fiscal loss and protect locals, private properties, and public facilities in the plan context based on the area. A local government, of course, can prepare its vulnerabilities of future frequent local natural hazards in advance. It shall be a long-term, consistent, clear, and effective way to pursue a sustainable development and positive community growth. Thus, this can discover any goal and objective related to flood mitigation at a local level.

4.2.1. Efforts to Discourage Development Activities Within Local Hazardous Areas

The best way to reduce hazard impacts is to prevent development activity within hazardous areas at the beginning of development. A local government may have abundant data related to a local hazard threat and the hazardous area. If a local government and elected official would have a strong and long-term commitment to reduce local hazard threats, they could prevent development activity at hazardous areas in an area. This makes a solid fiscal income of a local government. With a long-term point of view, however, it may help a local government save their extra money from the huge postdisaster costs by discouraging development activity within hazardous areas.

4.2.2. Efforts of Property Protection

It is definitely needed to protect private properties even if a local government would approve developments within a hazardous area. For example, there would be a strong building code for certain areas, high insurance rates, and specific site plans, including an environmental impact assessment.

4.2.3. Efforts for Natural Resources

In a local hazard mitigation plan or comprehensive plan, there should be some efforts to improve local natural resources, such as water resources, through stormwater management, environmentally sensitive area, and other local unique resources. This can be viewed as giving back to nature.

4.2.4. Efforts to Repetitive Fiscal Loss

Local government revenue is quite limited to local priority businesses. Also, its source of income is too limited to spend it all local on priorities. When an emergency happens, this would be a serious problem for a local government thus, there should be some efforts to maintain local fiscal status and, ultimately,

protect local fiscal losses through many administrative activities.

4.2.5. Efforts to Promote a Sustainable Community (Recreational Area/Preservation Open Space)

Hazard mitigation efforts have been fundamentally included in the idea of sustainability. Environmentally sensitive areas should be given back to nature. The least structural measurements need to be implemented in a local area. By doing that, many environmental areas can be preserved, and these areas can be developed as an environment-friendly recreational area for the citizens.

4.2.6. Efforts to Public Institution Facility

Public institution facilities are regarded as the core of local vitality. Of those, a city hall and elementary schools in Japan can be an important factor. It is necessarily that their locations and building codes be checked. Thus, there should be some effort to improve their functions and capacities.

4.2.7. Efforts to Local Awareness Promoting

Awareness systems have been identified as the cornerstone in many studies. In practice, there have been good examples showing how important awareness systems are. In the plan, the kinds of effort needed to improve local awareness systems should be checked. Additionally, many technical improvements have been made in recent decades such as IT, cellphones, and high speed internet. Therefore, there should be some effort to intermingle the above technologies into the current system.

4.2.8. Efforts to Improve Communication and Coordination

Specifically, communication and coordination can be divided into two separate sections: administrative and community. This is a critical part of communication between the local governments/ communities and academia/communities. It is well known that natural hazards and environmental issues are not limited to one jurisdiction but are transboundary. There should be efforts to make it clear to better communicate and effectively coordinate among entities on goals and objectives in a LHMP. Explicitly, the communication with the public should be an important issue in the procedure when making an LHMP. Furthermore, the coordination should be handled very carefully. In a LHMP, there should be information on how to deal with coordination with local governmental entities. One example can be a regular meeting to discuss natural hazard issues between adjacent local governments.

4.3. Implementation and Action

This part will be the most important one of the three categories in evaluating a plan context because any

efforts for goals and objectives could be useless if there is no clear checkup system, time schedule for a certain implementation commitment, feasible financials, and necessary technical support. This section will include what actions/implementations are associated with reducing housing or public institutional facilities damage and recovery efforts and then increasing emergency awareness, alert systems, and public participation, followed by incentives.

4.3.1. Checkup System

This is one of monitoring systems. For example, one city sets up the goal to protect riverside housing from flood events. The city would plan many possible alternatives within the city's feasible fiscal status. There should be proper checkup systems so that public officials could check that those projects are processing as they are expected. This checkup system will include who, when, and where information is so that feedback from the meeting will be a virtuous circle.

4.3.2. Proper Time-Schedule

Every project to protect citizen properties and lives should have a fine time schedule. This is common-sense if the mitigation plan would be project based. However, currently, the KCRHPP and SMP are, not project-based plans. For that reason, it would be hard to find items in the KCRHPP and SMP. However, it is strongly recommended that the time schedule for a certain project, which can be a community's goal and objective, be open to the public to know of infrastructure improvements. It would be highly possible for the information to be scattered into other plans. However, the above information should be combined into one plan, such as a LHMP, emergency plan, or comprehensive plan.

4.3.3. Public Participation Skills

This item can be involve communication and coordination categories. However, the coordination category in other countries cannot be the same for the US, which has three different governmental entities (federal, state, and local government). Therefore, they have to intimately coordinate with governmental entities to make a better result, not only in the urban planning issue but also in the other issues. Nevertheless, the communication and coordination categories should also be treated as a high priority in Japan. That is because the locals know local problems, such as geographical features and chronic, local natural threats, more than any organizations. Therefore, the plan includes how much the locals get involved when the implementations/actions have been enacted, and it should identify the relationship between a local government and the public, including stakeholders.

Therefore, it is extremely important that participation skills be applied in order to boost citizen participation on a local hazard mitigation plan procedure. It is necessary whether or not there are ordinances that locals can actively take part in planning a procedure.

As mentioned, the better the result of an assessment, the more indicators we would use. However, there are many impediments that we have to consider. First, the United States and the other two countries have a different political system. This different political system makes two different items; the other two countries can be quicker in their response when the events occur. On the other hand, plans in the United States can be assessed at different levels, at least three times from local to federal. For example, a local government should meet a guideline which a state government set up in order to get funding sources for making plans, including general plans, comprehensive plans, and hazard mitigation plans. This is the same way for a state government to the federal government. Of course, even though not all states require plans, almost half of the states in the United States require preparing plans as mentioned above. Berke and French (1994) compared local plan quality measures with and without state planning mandates in five states (California and Florida for the mandate, Texas and Washington for the nonmandate, and North Carolina only for coastal jurisdiction). Their findings cannot be exactly applied to other countries due to political and cultural reasons. However, some common findings are interesting. State planning mandates had a positive effect on awareness, regulatory, incentives, infrastructure, recovery, and preparedness in a natural hazard mitigation point of view in the sample plans. In addition, hazard goals and environmental goals in plans were higher in the mandate communities than the nonmandate communities. Specifically, some findings that have to be seriously taken into account are local commitment building/ capacity building and clearer state mandate goals. Interpreting local commitment building is for state officials to encourage local government to value plans and plan making, which educates the elected and appointed officials and also provides incentives to support local planning. In other words, the bottom line is that stricter and clearer state mandate goals lead local governments to make stronger plans that are specified in a plan format (mentioned as structural and facilitating feature).

On the other hand, there is also research that displays very different results. Bunnell and Jepson (2011) argue that state mandate planning resulted in worse consequences, at least in communicative and persuasive plan quality aspects. The protocol used in their research was a little different than Berke,

Godschalk, and Kaiser's. They insisted that state or local planning mandates would not have a positive effect upon a local plan's creativity, originality, and narrative quality. Rather, plans without force would induce local communities' effort to make their plans stronger and more unique only for their communities. They basically denied that state mandate planning always produces a worse plan. However, it would be possible that mandating would possibly have a negative effect upon its creativity and own originality in a plan preparation period. From such a viewpoint, this research would be very fresh to approach plan quality measurements. For this reason, it is necessary that the top-down approach as a plan quality measure and the bottom-up approach as citizen input and community participation are well organized in a plan-making process.

This research specifically evaluated each city hazard mitigation plan quality with the above mentioned qualities among three countries: Japan, the United States, and Republic of Korea. All study sites have faced flood natural hazards as a major threat. Indicators in this research will focus on very common facts, goals, and actions, such as socioeconomic status (SES), local government commitment to reduce potential losses, and preparedness for the future events because of political and cultural differences. This protocol would be the best one that compares other countries' plans. That is because it is based upon the fact-oriented measure and can minimize evaluators' subjectivity. Measurements of plan quality were calculated by the sum of scores obtained by each indicator analysis in the plans. Each indicator under three categories will analyse the extent to which the detailed information in a plan was included. It is suggested that plans include a strong commitment to achieve proposed goals and policies. Therefore, to get higher scores (score=2) at a certain indicator, the text in a local plan should display a strong willingness to implement policies, such as the terms *shall*, *will*, or *must*. The score will be 1 if a willingness in a local plan to execute policies is weaker than the above terms, such as the terms *suggested*, *encourage*, or *consider*. The item or indicator will be scored as 0 if there are no terms indicating willingness mentioned at all for that indicator. Finally, the score of the indicators will be summed under each category (Fact, Goal, and Action).

$$PC_j = 10/2m_j \sum_{i=1}^{m_j} I_i$$

$$TPQ = \sum_{j=1}^3 PC_j$$

Where PC_j is the quality of the j th plan category (ranging 0–10), m_j is the number of indicators within the j th plan category, I_i represents the i th indicator's score (ranging from 0–2); and TPQ is the total scores of a whole plan (ranging from 0–30).

The score will be divided by the total possible maximum scores in each category. The total possible maximum scores depend upon the number of indicators. The score will be 20 if a number of indicators are ten under the Fact category (Berke, Godschalk, & Kaiser, 2006; Berke & Conroy, 2000). Research team members consisted of two professors, one researcher, and three graduate students, including the authors. Three graduate students conducted the plan quality evaluation of countries, of which each student was in charge of one country. One of authors conducted two plan quality evaluations: Korea and the United States. One graduate student from Korea conducted the evaluation of Korea. The other graduate student from Jamaica took the Baltimore plan. Of course, the evaluation of Kumamoto was conducted by professors, researchers, and graduate students. Due to the fact that the research members were three different nationalities, there may be different interpretations for each LHMP evaluation. For that possible reason, there were three meeting times for Kumamoto and two meeting times for Pohang and Baltimore. At the meetings, each evaluator discussed reducing the interpretation error when assessing a plan. The authors acted as facilitators for each meeting because those meetings were conducted in different languages: Japanese, Korean, and English.

5. RESULTS

Overall, there were relatively low scores in two countries, Japan and Korea. This result was somewhat expected because the plan protocol, indicators used in the evaluation process, and previous studies referenced here were from the North American literatures. One interesting thing is that the SMP in Pohang was overwhelmingly long, about 800 pages. It was, of course, because the SMP deals with all possible natural hazards and all man-made safety-related accidents. This would be too much as a plan, compared to DP3 for Baltimore which is around 300 pages long.

5.1. City of Baltimore, United States

In the plan, major flooding events in Baltimore are the result of riverine flooding along the stream tributaries of the Patapsco River and riverine flooding usually from persistent rain or snowfall. This trend is very similar with Kumamoto. Overall, Baltimore's DP3 was well organized and prepared for future disasters, considering many other scenarios.

Table 4. The analysis for DP3, Baltimore LHMP

FACT	GOAL	ACTION	TPQ
9.38/10.00	10/10.00	10/10.00	29.38/30.00

Table 5. The analysis for KCRHPP, Kumamoto LHMP

FACT	GOAL	ACTION	TPQ
5.63/10.00	5.00/10.00	6.67/10.00	17.30/30.00

Most indicators were well explained with the related maps in the plan.

5.1.1. Fact

The plan addressed hazard history of the city, current population, and future population growth trends in text and maps. By using GIS, Baltimore provided related information for their citizens. Specifically, the plan included very detailed information for single-headed households, such as male head of households with children under 18 and female heads of household with children under 18. In GIS maps, there were even median household incomes, high school diploma and above rates, employers with 250+ employees, and house tenure-renter occupied. They also identified who and what may be vulnerable to flooding in a 100-year and 500-year floodplain.

In addition, they have an emergency action plan (EAP) and emergency plan for every possible hazard scenario.

One thing they did not include in the plan was the number of private facilities there are within the floodplain. However, they estimated values of private and critical facilities within the 100-year and 500-year floodplains and provided the number of critical facilities on maps.

5.1.2. Goal

The city of Baltimore has been providing strong commitments and goals to protect their citizens and environment. The following is their vision on the plan:

Baltimore will be a city whose daily activities reflect a commitment shared by government, business, and citizens to reduce or eliminate impacts from current and future natural disasters.

To achieve their goals and objectives, they list four sections in the Strategy and Action chapter: Infrastructure, Building, Natural System, and Public Service.

Each indicator was well explained by possible strategies and actions, time schedules, implementation guidelines, related organizations, and priorities. So as to overcome their future possible weather-related disasters, they update their building codes, regulate buildings within a floodplain or near the waterfront, use zoning and subdivisions,

and actively use acquisitions for repetitive loss buildings. They clearly describe how to maintain and update critical public facilities, such as fire stations, police stations, hospitals, and hazardous materials storage sites. Basically, all goals and objectives were found in each project, and there was a description about leading agencies and stakeholders, estimated timeframe, and financing options.

5.1.3. Action (Implementation)

It is documented that every local government develops and adopts all hazard mitigation plans and requires jurisdiction to update it every 5 years. Again, the plan is basically project-oriented, so actions and implementations are explained well. Besides, all projects are well connected with other governmental organizations. Finally, the plan encourages designating community leaders and organizations that assist and provide support during hazard events.

5.2. Kumamoto, Japan

The most impressive thing was that there were not enough hazard maps in KCRHPP, Kumamoto's LHMP. However, it addressed the addresses of potentially dangerous areas such as flooding and landslides on the horizon. Total Plan Quality (TPQ) was quite lower than our team expected. Nevertheless, the plan was evaluated positively due to the fact that it includes detailed information for potential hazardous areas, building names, downtown underground areas, but not maps for them. The following is the descriptive analysis for the plan.

5.2.1. Fact

In this case, a score of 0 was assigned to the following missing indicators in the plan: the number and location of single heads of households, the number and location of local critical facilities, the number of private structures exposed to natural hazards, the median household income in Kumamoto City, the number of households with income below the median income, and households below the poverty line. It is possible that some indicators cannot be made public, such as the number of households below the poverty line and the number of single heads of household. With respect to SES, specifically in a hazard mitigation plan, these are all very important indicators revealing which citizens will be easily exposed to threats when disasters occur. Apparently, they do not have many opportunities to obtain proper information in sufficient time to respond.

5.2.2. Goal

The Goal category gained the lowest points among the three categories. However, it does not mean that

KCRHPP did not describe its goals and objectives to protect citizens and the city. It is strongly believed that our indicators in the plan are not easy to find. For examples, we could not find the following: effort to discourage development activity within local hazardous areas, any efforts of property protection, and any effort to maintain public facilities. The above efforts are deeply related to mitigate the possibility of local hazard loss when events occur. Actually, the city is constructing levees along the Shirakawa River. Again, it would be possible that the locals would have a false sense of security and also increase potential damage areas and cost. regarding the false sense of security, the authors do not argue that a structural method is not good for an environment-friendly city. However, both should be balanced. For example, there should be administrative efforts like acquisition or taking households in repetitive damaged area. In Japan, an elementary school district is the smallest unit thto which citizens can evacuate. Local elementary schools are the shelter for citizens when hazards occur. Based on the evacuation plan and route, the locals should remember where the closest elementary school is and evacuate to it when disasters happen. Therefore, any effort to maintain public facilities is one of the critical goals in a LHMP. Also, the local government has to try its best to inform their citizens where shelters are and to maintain those facilities. There is a very strong goal in the plans called "effort to improve communication and cooperation between jurisdictions." As highlighted by many researchers, extremely severe natural hazards or man-made hazards are never limited to one jurisdiction, but are transboundary. Therefore, it is highly critical that adjacent jurisdictions have adequate communication channels, regulations, and plans to help one another. On this point, KCRHPP has a good quality of communication and cooperation among adjacent jurisdictions.

Actually, a large quantity of the plan is assigned in the section, "Goals and Objectives." However, much of the information is scattered in the plan. It should be combined so that local officials can easily maintain broad goals and detailed objectives.

5.2.3. Action (Implementation)

This component has the least indicators in this evaluation: proper checkup system (monitoring), precise time schedule for certain implementations/policies, and citizen participation. However, all of them are very important factors. In spite of importance, there are only three indicators because of different political systems, the plan-making process, and culture.

In the KCRHPP, it is very hard to find an action plan, monitoring system, or implementation for a local governmental commitment in the proposed policies. Fundamentally, it can be said that there are not many monitoring systems for implementation and action in the KCRHPP, based on our research. It is strongly believed that implementation of proposed policies and monitoring systems for them has definitely played an important role in managing local government commitments to make communities resilient against certain natural hazards. Unfortunately, we cannot find direct citizen participation with regards to the plan-making process. There are, of course, many indirect citizen inputs, such as public hearings, forums, and other types of participation. However, it is not possible for you to check that the contents of a public hearing are applied to a plan or not if there is no proper system or local ordinance.

5.3. Pohang, South Korea

The SMP obtained the lowest TPQ among the three countries. This is not a surprising result due to the fact that Korea is a developing country, at least in dealing with the hazard issues.

5.3.1. Fact

First of all, the length of the SMP is problematic. While the length of plan would not adversely affect the plan quality at all times, the plan quality would be affected by complexity and the complexity is related to length of descriptions. Overall, many indicators are missed under our three categories. Population growth pattern and population within floodplain are not found in the SMP. There is one table for explanation of a precautionary evacuation plan, P-EP. This table shows why certain areas were designated as P-EP, affected households, number of shelters, shelter capacity, number of the vulnerable population, and number of staff members. There are no maps for the above information, and the plan mentioned that the local government appointed "Frequent Vulnerable Areas" and "Frequent Natural Hazard Dangerous District." Again, maps related to those districts were not found in the SMP. Many parts of the plan were allocated to a systematic flow chart for emergency evacuation, response processes, and recovery funding sources from the central government. Also, it mentioned the number of shelters and capacities of them but did not describe where they are.

It is very hard to recognize the population projection, future development pattern for population growth

Table 6. The analysis for SMP, Pohang LHMP

FACT	GOAL	ACTION	TPQ
3.12/10.00	3.74/10.00	6.67/10.00	13.53/30.00

patterns, and where the vulnerable people mostly live. There was not information for single headed households, median household income for the locals, or households below poverty. The critical information, the vulnerable and dependent people for natural disasters, is not known from the SMP.

5.3.2. Goal

In this category, there were many missing indicators: efforts to discourage development activities within local hazardous areas, efforts to protect properties, efforts to preserve natural resources, efforts to minimize local fiscal losses from natural hazards, and efforts to maintain public facilities. Most indicators in this category focused upon recovery actions which are post event.

Promoting awareness and improving communication and coordination were well explained in the plan. Specifically, improving communication and coordination was organized from military to local government and the locals, which is called the Civil-Official-Military response system.

5.3.3. Action (Implementation)

These three indicators were obscurely mentioned in the plan but were definitely in the plan. The SMP is updated every year, and the impressive thing is that civilian monitoring committee activities were encouraged in the plan. As the same with Kumamoto, Japan, the SMP is not a project-oriented plan. Therefore, precise time-schedule were not expressed for certain mitigation projects or implementations. However, one chapter of the plan allocated a finance and investment plan for hazards, including wind, flood, red tide, wildfire, and infection by animals and humans. Unfortunately, this was not detailed information. The table explained the past year, 2012, and current year, 2013.

6. IMPLICATION AND RECOMMENDATION

This research was time consuming because a whole plan should be scrutinized several times. However, we strongly believe that the plan evaluation for a local community should be regularly conducted to determine if the LHMP is strong enough to protect the locals and their properties. Kumamoto earned 57% of the total possible score and Pohang earned 51.77%. These scores are not good enough, even though there is a specific cutoff line for the evaluation of LHMP. Based on this result, we may say that KCRHPP and SMP do not prepare cities well for the potential local natural hazards in the predisaster period. One thing we pay attention to is the length of plan. The SMP is over 800 pages. Even though it covers all hazards from natural to epidemic, this bulkiness does not guarantee plan quality. Furthermore, the TPQ scores are much lower than we expected in both countries, specifically Pohang.

This would be due to the extraordinarily low score of the Implementation/Action plan component in Kumamoto. Pohang and Kumamoto should concentrate their efforts on fact finding related to natural hazard vulnerable areas and people. The fact component should be enhanced because this is the starting point to make communities resilient. The goal/objective plan component is also relatively low in both KCRHPP and SMP. This is caused by the plans not being project-oriented. This reason also applies to the third component, Implementation/action, and the extremely low scores in Kumamoto. There is related information for financing support and investment plans for disaster mitigation in Pohang but that part should be more detailed and clear.

The KCRHPP and SMP contain huge amounts of information, but are still too vague for flood threats. That is, the KCRHPP and SMP are not for predisaster planning but more likely for during/postdisaster planning. In addition, if some information could not be written on the plan due to privacy, relevant information should be easily found when it is needed. To do so, it is, again, highly critical that a high level of communication and cooperation exists between relevant city departments and not only the emergency departments. This way, local governments can better take care of their dependents, such as the elderly, children, the disabled, and social minorities, not only during emergencies but also in daily life. In the third component, there are no strategies and tactics in order to stimulate public participation into making a mitigation plan process. Citizen participation and public input should be actively performed when the KCRHPP and SMP are updated. That is, both approaches, top-down and bottom-up, are integrated into the plan. It gives strong motivation for the cities to put citizen participation into plan making procedures as well as makes citizens be more than bystanders or free riders, but proactive actors. This is so called *Machi-dukuri* in Japan, which is community making. As mentioned in the introduction, local citizens know their repetitive natural hazards and vulnerable spots in their communities better. To fully use their knowledge and emergency training, public input and active citizen participation should be institutionalized into local city ordinances.

There are four recommendations based upon this result:

1. The KCRHPP contains a large amount of information and is very systematic, but is not detailed on specific individual points. Even though we have only focused on flooding in this research, it actually covers other natural and man-made hazards. That is good for locals, but the LHMP should be more detailed, not vague.

2. The KCRHPP and SMP should be a project-oriented plan. As seen in the implementation/Action plan component, it does not include any kind of implementation/action for the future hazard mitigation project. That is the reason that there was no time schedule for any project at all. If the KCRHPP and SMP would be more project-oriented, local officials could find all necessary data or information at once. This would make sufficiently improve the working efficiency of local officials.
3. Detailed maps are needed in the plan. In the KCRHPP, there is only one map for geographic purposes. However, it is absolutely necessary to publically provide more information through maps, such as local land use, 100-year floodplains, and frequent flooding area maps. Even if a local government would have a stand-alone plan for each hazard, each plan should have a land use plan for future disasters so that local officials can recommend policymakers and elected officials to update future local development plans. Furthermore, a 100-year floodplain map would improve evacuation time, minimize potential economic loss, and optimize housing choice patterns. Of course, there is the map called the "Hazard Map"; however, it is not currently included into the KCRHPP, although it is available to the public. One concern about this map is that it covers too much information on a small, one page paper. This type of map could possibly confuse people who need to read it when real disaster occurs. Therefore, there should be solid improvements in the design of the Hazard Map. For example, all of the information does not need to be on a single map except for the 100-year floodplain, 500-year floodplain, and shelters. Also, we propose that the local government should make an independent evacuation route map based on elementary school districts, which is called *Machi* in Japan, so that the locals can more easily read the map.
4. In order to make the incorporation of the first three recommendations above possible, the local government should integrate stand-alone hazard plans into the local comprehensive plans. We do not argue that stand-alone plans are inadequate for dealing with local natural hazards. It is definitely needed in some places, such as nuclear power plants, areas with strong wind, and potential tsunami-prone regions. However, a local comprehensive plan covers all

categories from current to future community growth management. Therefore, many hazardous areas can be view as a developable one when the plan would be established. It would be very effective and efficient because relevant people such as local planners, emergency managers, the fire chief, police, local economic officials, etc., can get together to share ideas and plans.

7. DISCUSSION AND CONCLUSION

Baltimore is actively using acquisitions for repetitive damaged properties by analysing National Flood Insurance Program (NFIP) claim payments. Also, Kumamoto has related ordinances and funding sources from the central government. Unfortunately, these are not properly used before a disaster strikes. Many people who live in dangerous areas for landslides or floods do not want to leave their houses. There would be many reasons for this. However, so as to reduce and decrease the number of potential victims and property damages, these policies are actively applied to land use practice. Land use practice will minimize unnecessary exposures of population and structures in hazard-prone areas (Lindell & Prater, 2003).

Based on each plan of the countries, Kumamoto and the Baltimore are working well on consensus during the plan-making process. Korea, however, needs more efforts on citizen involvement during the plan-making process. Also, Kumamoto City is currently making community-based hazard maps that each community citizen gets involved with for the next 3 years. Furthermore, Kumamoto City has a plan that adopts more proactive evacuation, which is a precautionary evacuation. Many studies of risk perception have been introduced with regard to risk reducing or mitigation (Cho & Lee, 2006; Martin, Martin, & Kent, 2009; Paton, Smith, Daly, & Johnston, 2008). They argued that high self-efficacy would increase protective activities on their properties and try to avoid risky situations. These contributions should be added into a plan. To succeed in precautionary evacuation in a local area, there should be proper education systems between locals and local governments. This would also be related to psychological components so as to better understand peoples' behaviors. All this processing should be carefully managed. Apparently, related ordinances should be embedded into a plan for people to get involved.

The SMP needs to be more concise and focused on fact finding on maps. The bulkiness of the plan does not mean that it covers all important factors as a LHMP. Currently in Korea, natural and man-made hazard issues are rapidly increasing because of

worldwide climate change and nuclear plants due to safety issues arising from the use of unauthorized parts. It is time to check that there is a proper manual in Korea. Korea is not safe anymore when it comes to natural hazards.

Plans are different and diverse, depending upon states in the US. Local governments, of course, have different manpower for hazard mitigation efforts. However, Japan and Korea have one main structure of hazard mitigation plan from the central government. LHMP requires more uniqueness for the local conditions. Bunnell and Jepson (2011) argued that mandating a plan-making process leads the plans to be unimaginative productions that are less creative. However, a rigid form and structure of LHMP through much research would make communities resilient with regard to natural hazards. There should be more efforts to add local uniqueness and creativity and even alternative scenarios for the future. It is also time to think carefully why we prepare for a mitigation plan, who the readers are, and who the users are for it.

REFERENCES

- Alterman, R., & Hill, M. (1978). Implementation of urban land use plans. *Journal of the American Institute of Planners*, 44(3), 274–285. <http://dx.doi.org/10.1080/01944367808976905>
- Baer, W. C. (1997). General plan evaluation criteria: An approach to making better plans. *Journal of the American Planning Association*, 63(3), 329–344. <http://dx.doi.org/10.1080/01944369708975926>
- Berke, P. (1998). Reducing natural hazard risks through state growth management. *Journal of the American Planning Association*, 64(1), 76–87. <http://dx.doi.org/10.1080/01944369808975958>
- Berke, P., Backhurst, M., Day, M., Ericksen, N., Laurian, L., Crawford, J., & Dixon, J. (2006). What makes plan implementation successful? An evaluation of local plans and implementation practices in New Zealand. *Environment and Planning B: Planning and Design*, 33(4), 581–600. <http://dx.doi.org/10.1068/b31166>
- Berke, P. R., & Conroy, M. M. (2000). Are we planning for sustainable development? An evaluation of 30 comprehensive plans. *Journal of the American Planning Association*, 66(1), 21–33. <http://dx.doi.org/10.1080/01944360008976081>
- Berke, P. R., & French, S. P. (1994). The influence of state planning mandates on local plan quality. *Journal of Planning Education and Research* 13(4), 237–250. <http://dx.doi.org/10.1177/0739456X9401300401>
- Berke, P. R., Godschalk, D. R., & Kaiser, E. J. (2006). *Urban land use planning (5th ed.)*. Urbana, IL: University of Illinois Press.
- Brody, S. D. (2003a). Are we learning to make better plans? A longitudinal analysis of plan quality associated with natural hazards. *Journal of Planning Education and Research*, 23(2), 191–201. <http://dx.doi.org/10.1177/0739456X03258635>
- Brody, S. D. (2003b). Implementing the principles of ecosystem management through local land use planning. *Population and Environment*, 24(6), 511–540. <http://dx.doi.org/10.1023/A:1025078715216>
- Brody, S. D. (2003c). Measuring the effects of stakeholder participation on the quality of local plans based on the principles of collaborative ecosystem management. *Journal of Planning Education and Research*, 22(4), 407–419. <http://dx.doi.org/10.1177/0739456X03022004007>
- Brody, S. D., & Highfield, W. E. (2005). Does planning work? Testing the implementation of local environmental planning in Florida. *Journal of the American Planning Association*, 71(2), 159–175. <http://dx.doi.org/10.1080/01944360508976690>
- Bunnell, G. & Jepson, E. J. (2011). The effect of mandated planning on plan quality. *Journal of American Planning Association*, 77(4), 338–353. <http://dx.doi.org/10.1080/01944363.2011.619951>
- Burby, R. J. (1998). *Cooperation with nature: Confronting natural hazards with land use planning for sustainable communities*. Washington, D.C.: Joseph Henry Press.
- Burby, R. J., Deyle R. E., Godschalk, D. R., & Olshansky, R. B. (2000). Creating hazard resilient community through land-use planning. *Natural Hazards Review*, 1(2), 99–106. [http://dx.doi.org/10.1061/\(ASCE\)1527-6988\(2000\)1:2\(99\)](http://dx.doi.org/10.1061/(ASCE)1527-6988(2000)1:2(99))
- Cho, J., & Lee, J. (2006). An integrated model of risk and risk-reducing strategies. *Journal of Business Research*, 59(1), 112–120. <http://dx.doi.org/10.1016/j.jbusres.2005.03.006>
- Deyle, R. E., & Smith, R. A. (1998). Local government compliance with state planning mandates: The effects of state implementation in Florida. *Journal of the American Planning Association*, 64(4), 457–469. <http://dx.doi.org/10.1080/01944369808976004>
- Godschalk, D. R., Beatly, T., Berke, P., Brower, D. J., & Kaiser, E. J. (1999). *Natural hazard mitigation: Recasting disaster policy and planning*. Washington, D.C.: Island Press.
- Hill, M. (1968). A goals-achievement matrix for evaluating alternative plans. *Journal of the American Institute of Planners*, 34(1), 19–29. <http://dx.doi.org/10.1080/01944366808977215>
- Lindell, M., & Prater, C. S. (2003). Assessing community impacts of natural disasters. *Natural Hazards Review* 4(4), 176–185. [http://dx.doi.org/10.1061/\(ASCE\)1527-6988\(2003\)4:4\(176\)](http://dx.doi.org/10.1061/(ASCE)1527-6988(2003)4:4(176))

- Martin, W. E., Martin, I. M., & Kent, B. (2009). The role of risk perception in the risk mitigation process: The case of wildfire in high risk communities. *Journal of Environmental Management*, 91(2), 489–498. <http://dx.doi.org/10.1016/j.jenvman.2009.09.007>
- Matsuda, Y., & Okada, N. (2006). Community diagnosis for sustainable disaster preparedness. *Journal of Natural Disaster Science*, 28(1), 25–33.
- Nelson, A. C., & French, S. P. (2002). Plan quality and mitigating damage from natural disasters: A case study of the Northridge earthquake with planning policy considerations. *Journal of the American Planning Association*, 68(2), 194–207. <http://dx.doi.org/10.1080/01944360208976265>
- Paton, D., Smith, L., Daly, M., & Johnston, D. (2008). Risk perception and volcanic hazard mitigation: Individual and social perspectives. *Journal of Volcanology and Geothermal Research*, 172(3–4), 179–188. <http://dx.doi.org/10.1016/j.jvolgeores.2007.12.026>
- Tang, Z. (2008). Evaluating local coastal zone land use planning capacities in California. *Ocean & Coastal Management*, 51(7), 544–555. <http://dx.doi.org/10.1016/j.ocecoaman.2008.06.001>
- Tang, Z., Bright, E., & Brody, S. D. (2008). Evaluating California local land use plan's environmental impact reports. *Environmental Impact Assessment Review*, 29, 96–106. <http://dx.doi.org/10.1016/j.eiar.2008.03.002>
- Tang, Z., & Brody, S. D. (2008). Linking planning theories with factors influencing local environmental plan quality. *Journal of Environmental and Planning: Planning and Design*, 36(3), 522–537. <http://dx.doi.org/10.1068/b34076>
- Tang, Z., Brody, S. D., Quinn, C., Chang, L., & Wei, T. (2010). Moving from agenda to action: Evaluation local climate change action plans. *Journal of Environmental Planning and Management*, 53(1), 41–62. <http://dx.doi.org/10.1080/09640560903399772>
- Tang, Z., Lindell, M. K., Prater, C. S., & Brody, S. D. (2008). Measuring tsunami planning capacity on U.S. Pacific coast. *Natural Hazards Review*, 9(2), 91–100. [http://dx.doi.org/10.1061/\(ASCE\)1527-6988\(2008\)9:2\(91\)](http://dx.doi.org/10.1061/(ASCE)1527-6988(2008)9:2(91))
- UNISDR. (2014). *Disaster statistics*. Retrieved from <http://www.unisdr.org/we/inform/disaster-statistics>
- Yamada, F., Kakimoto, R., Yamamoto, M., Fujimi, T., & Tanaka, N. (2011). Implementation of community flood risk communication in Kumamoto, Japan. *Journal of Advanced Transportation*, 45(2), 117–128. <http://dx.doi.org/10.1002/atr.119>
- Zhang, Y., Lindell, M. K., & Prater, C. S. (2009). Vulnerability of community businesses to environmental disasters. *Disaster*, 33(1), 39–57. <http://dx.doi.org/10.1111/j.1467-7717.2008.01061.x>
- Zhang, Y. (2010). Residential housing choice in a multihazard environment: Implications for natural hazards mitigation and community environmental justice. *Journal of Planning Education and Research*, 30(2), 117–131. <http://dx.doi.org/10.1177/0739456X10381386>