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Effective Disaster Prevention or Mitigation by Examining the Significance of Disaster Resilience

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Abstract

The purpose of this study is to suggest some implications for effective disaster prevention or mitigation through examining the significance of disaster resilience. As a result, some major implications of this study are as follows; serious and in-depth cause analysis should be conducted to mitigate or minimize the likelihood of recurrence of the same type of disaster from past disasters; the cooperation between the disaster management institutions should be practically established; public officials should personally engage in responsible actions to prevent disasters and mitigate damage; it is necessary to increase the level of cooperation and information exchange between the central and local governments responsible for disaster management, public officials with disaster experience and public officials without disaster experience, and public sector and private sector; a depth academic research should be conducted to analyze the impact of disaster on individuals, households and society, etc.

Key words: disaster resilience, prevention, mitigation, disaster management

Ⅰ. INTRODUCTION

Disasters are social events. Unless the event impacts people, it is exactly not a disaster. For example, if a tidal wave totally covered an island not inhabited by people, the event would not be considered a disaster (Phillips, *et. al.*, 2017: 67). Disaster situations can cause a social shock to a certain group of people, and disaster-stricken areas and people need to assist from outside. Disaster management has been increasingly recognized as more complex and comprehensive than the traditional perception. The basic function of the government is to protect life and property of people. The government's measures, therefore, include not only a reactive response to disaster but also a method

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to avoid the disaster and a countermeasure (Cigler, 1988: 39).

Prevention must be the best way to ensure the effectiveness of disaster management policies. It may not be possible, however, to prevent the occurrence of the disaster itself. For example, in the case of natural disasters such as typhoons, earthquakes, tsunamis, heat wave, and so on, we cannot prevent a disaster from occurring in advance by efforts. We must not only aim to prevent the occurrence of disasters, but also take mitigation efforts in order to minimize the hazard caused by disasters. In order to ensure the effectiveness of the disaster management policy, the government should make efforts to prevent the disaster from occurring before it happens. At the same time, prevention and mitigation[1] efforts should be made to minimize the damage from the inevitable disaster. It will be helpful for the stability of economic development and the guarantee of national security and safety (An & Lee, 2017: 26).

Natural disasters are often national problems, while local governments are best able to respond and take steps to mitigate them (Birkland, 2006: 129). This is quite different from the case of aviation security. This is because of the reason that the regulation of aviation has long been a function of central government authority. Even though the local government tends to have the support of the central government even for relatively small "disasters", the policy on natural disasters is supported by the central government. Since local governments have long experience of natural disasters, because they understand fully the characteristics of their area and disaster. Additionally, local governments respond to emergencies daily by using their own resources. They also rely on mutual aid and assistance agreements with neighboring jurisdictions when they need additional resources. When local jurisdictions cannot meet incident response, resource needs with their own resources or with help available from other local jurisdictions; they may ask the state for assistance (Haddow, *et. al.*, 2014: 199). If necessary resources are inadequate, implementation is likely to be ineffective. Important resources include finances, adequate staff, and the information, authority, and facilities necessary to translate proposals into functioning public services (Ender, *et. al.*, 1988: 72).

Local governments, such as municipal and county governments, are preliminary link in the government's official response structure chain (Schneider, 1995: 29). The municipal and county governments are responsible for dealing with emergencies in their respective areas. The basic assumption is that law enforcement agencies and related organizations of local governments will mainly deal with disaster response.

In the meantime, we have classified disasters as natural disasters, man-made disasters, ecological disasters, etc. horizontally; they all have the same damage scale and extent. However, it can be classified vertically from the perspective of organizations, communities and resources that manage disasters. In other words, the hierarchy of disasters can be thought of as a three-floor

1) Mitigation can be defined as "any action that would lessen the impact of a natural disaster. Research on mitigation emphasizes a preference for policies that employ land-use controls, improved building codes, or actuarially sound insurance programs (Birkland, 2006: 106).

pyramid (Rubin, 2007: 35). On the first floor of the pyramid, there are emergencies such as fires, floods, landslides, and hazmat incidents that can be handled by local public agencies. On the second floor, there are events that are mainly handled by local governments but receive additional support from the state. There are a few disasters at the apex of the pyramid that require local, state and federal resources. Due to the size, nature and impact of these disasters, they tend to receive considerable attention from the media as well as constant attention from all levels of government.

Until now, international organizations and major advanced countries in disaster management have emphasized disaster resilience to ensure the effectiveness of disaster management according to the nature of disasters (Yu, *et. al.*, 2014: 76). In 2005, the United Nations (UN) adopted the concept of resilience in the Hyogo Framework for Action 2005-2015 on "Building the Resilience of Nations and Communities to Disasters." The US Department of Homeland Security recognized that it was not able to prevent the damage of the critical infrastructure from disaster. Thus, the 2009 National Infrastructure Protection Plan theme was "Partnering to Environment Protection and Resiliency." This emphasizes the importance of securing the resilience with the physical protection of the critical infrastructure. Australia is also pursuing Critical Infrastructure Resilience (CIR). In addition, Europe is holding a conference on "Critical Infrastructure Protection and Resilience Europe". In Asia, the Asian Development Bank and the Institute of Water Policy at ACCESS Congress 2013, held in Singapore in 2013, addressed the disaster resilience reinforcement as a main agenda. In addition, they agreed that it is important to secure resilience to manage disaster risk.

The purpose of this study is to suggest some implications for effective disaster management through examining the significance of disaster resilience and mitigation strategies. Furthermore, this paper explores the significance and importance of disaster management, review the meaning of resilience, disaster resilience and mitigation strategies before some implications.

II. SIGNIFICANCE AND EFFECTIVENESS OF DISASTER MANAGEMENT

Generally speaking, the concept of disaster was to refer to large scale natural disasters such as typhoons, floods, and earthquakes. However, due to the development of science and technology by industrialization and urbanization, in the modern society, as the damage of large scale human disaster exceeds the natural disaster. Therefore, it is used not only for natural disasters but also for man-made ones (Lee, *et. al.*, 2006: 109-110). At the same time, today, critical infrastructure paralysis, which is essential to ensuring and maintaining the viability of a nation as a community, is also observed as a major disaster.

However, the recent disasters are often in the form of complex disasters, which are difficult to distinguish between natural disasters, man-made disasters and critical infrastructure paralysis. In the case of the Fukushima explosion, the tsunami was triggered by a natural disaster, but massive damage was caused by a combination of human factors such as the complexity of nuclear technology and the wrong response to nuclear power plant

accidents (Park, 2015: 94).

As urbanization has increased the vulnerability of urban areas to risk, 14 of the world's 19 mega cities are in coastal zones at flood risk and over 70 of the 100 largest cities can expect a strong earthquake at least once every 50 years. Because earthquakes tended to be bigger disasters, in terms of damage, they made proportionately more people homeless (13%) and caused more damage (28%) (Platt, *et. al.*, 2016: 447).

Disasters can be defined as 'an event that causes extensive damage to human life, property and the community'.[2] In order to be classified as a disaster from ordinary events or accidents, large-scale damage must occur. It is not easy to set a standard for how much damage should occur so that it can be called massive damage. First, there must be consensus among community members that it is a massive damage. Disaster only has its meaning when it has a negative effect on society. There are a number of incidents or accidents that have a negative impact on the community, but disaster can be said to be a disaster when the perception of massive damage is shared among them. Second, the organization and system of the existing community should not be able to solve the problem alone. If disaster occurs, various organizations work together and take separate responses, in order to prevent large-scale disasters in advance or to make mitigation efforts to reduce damage, or to respond quickly. Third, additional resources must be used to solve the problem. For example, if events such as heavy snow, heavy rain, typhoons, and large fires occur, separate personnel, equipment, facilities, budgets, and legal systems will be mobilized. It is a disaster when additional resources are mobilized. Fourth, the subject of massive damage includes events that threaten the safety of the community as well as human life and property. Large damage to the critical infrastructure, which consists of necessary components to ensure, operate and maintain the viability of the community, such as finance, traffic and transportation, power, telecommunications, major industrial complexes, energy, nuclear power, and dams, as well as functions such as public health and public order, is also a disaster. It is necessary to understand its characteristics in order to protect the critical infrastructure and secure the resilience (Yu, 2011: 534). First, the critical infrastructure shows dependencies that are influenced by the state of other critical infrastructures. For example, disruption in power supply disrupts subway operations and logistics. Second, the critical infrastructure has interdependency. A power outage can disrupt logistics and poor logistics transportation can further exacerbate the outage by impeding the fuel supply needed to regenerate power. Third, the critical infrastructure has a cascade. If the logistics cannot be transported properly due to blackouts, domestic and foreign industrial activities may be reduced.

Since it is the role and responsibility of the government to manage and respond to a national disaster or crisis, the government has pursued various policies to enhance and formulate the effectiveness of disaster management. At the same

2) In this regard, the UNDP states that "disaster is a sudden event or catastrophe that disrupts the basic organization and normal function of society. The society affected by the disaster can not be overcome without outside help. And it is a single or series of events that cause damage to property, social infrastructure, or means of living beyond the scope of normal capacity" (Lim, *et. al.*, 1996: 10).

time, as the government defines the disaster or crisis as a serious and important issue, the burden of government disaster management will increase, and the level of social criticism against the government will increase. It is easy for the government to emphasize that the disaster or crisis occurs out of government responsibility to avoid accusations (Han, 2018: 282).

The government has established a disaster management system to prevent disasters, protect people's lives and property from their risks, and establish safety management and early response systems for disaster response in case of disasters (Lee, *et. al.*, 2006: 220). In designing a disaster management administrative system, it is desirable for Korean government and other international governments to shift the disaster management policy, which has been focused on response and recovery after a disaster, into a preventive disaster management policy. As a matter of fact, disaster management policy needs to improve disaster prevention and safety culture that may or even cause disasters. The US government has enacted the "Hazard Mitigation Act" in 2000 and recommended that all local governments establish a "Disaster Prevention Plan" by November 2003 to continue to receive federal government support. Through this, the US has been implementing preventive disaster management policies, and has created a huge safety culture from the federal government to members of the disaster community (Lee & Yang, 2005: 106).

Disaster management can be defined as "the process of preventing and preparing for disasters before they occur for the safety of people's lives, property and communities, and trying to respond and recover after disasters occur."[3] This definition clarifies that disaster management is also a process of disaster management, as well as post-disaster response activities and recovery efforts, as well as mitigation to prevent or minimize damage, and preparedness to respond quickly and efficiently in the event of an actual response. The Framework Act on Disaster and Safety Management (article 3), also provides that "disaster management refers to all activities for prevention, preparedness, response and recovery of disasters". It is interpreted as the broad concept of eliminating the risk of disasters and covering all the activities of disaster recovery in the event of a disaster (Lee, 2018: 246). There is also an opinion that emphasizes minimization of the damage caused by disasters rather than preventing the occurrence of disasters themselves. Kang(2009: 799) defines disaster management as all activities related to preventing, preparing, responding to, and recovering from disasters in order to minimize the damage caused by disasters. And the concept of disaster management in accordance with the vulnerability theory begins with activities that reduce disaster damage, namely identifying vulnerable parts of a building from natural disasters

3) Derived from the Latin term *vulnerabilis*, which means "to wound," vulnerability is a measure of the propensity of an object, area, individual, group, community, country, or other entity to incur the consequences of a hazard. This measurement results from a combination of physical, social, economic, and environmental factors or processes. Vulnerability can be decreased through actions that lower the propensity to incur harm, or it can be increased through actions that increase that propensity. For instance, retrofitting a building to withstand the shaking effects of an earthquake will lower that building's vulnerability to the hazard, lowering risk. (Resilience, the opposite of vulnerability, is a measure of propensity to avoid loss.) Populations have vulnerabilities as well, which are raised or lowered according to their practices, beliefs, and economic status (Coppola, 2015: 33).

that we can easily think of. In addition, it can be seen as managing not only the damage of the disaster but also the victims and casualties of the disaster area, the response system, prevention and management system, disaster indicators, and vulnerable groups (Kim & Hong, 2017: 144). In Kim & Lee (2008), 'prevention' refers the activities taken from a long-term perspective in order to reduce the degree of risk, and 'preparation' refers to preliminary activities for effective response in case of emergency. 'Response' refers to lifesaving, loss of property damage, emergency recovery activities, etc. taken during a disaster, and 'recovery' is an ongoing activity to support the affected area until it is restored to its original condition.

In several cases, disasters are not reasonably predictable or controllable. In the event of a disaster, it is possible for local residents and citizens with more experience and knowledge on the site to perform their initial response more effectively than government officials or experts. Thus, the disaster management paradigm, which only experts and state officials can effectively lead and organize preparedness and response to disasters, is fundamentally limited (Lee, 2014: 62-63). Of course, for the people who are affected, no disaster is ever really normal. However some types of disasters such as floods, droughts, and minor typhoons do occur with regularity. Emergency management agencies usually respond to these situations in a straightforward, almost automatic manner. The governmental responses to these kinds of situations are usually quite successful. Governmental institutions are more attuned to these situations, and they have designed a response system with exactly these conditions in mind (Schneider, 2011: 196).

Ⅲ. DISASTER RESILIENCE AND MITIGATION STRATEGY Resilience

Resilience was originally used in Physics to mean the pliancy and elasticity of a material that can return to its original state when pressure is applied. In computer science, resilience is observed as 'disability tolerance'. This is the ability of a computer or operating system (OS) to prevent data loss or damage to ongoing operations when a situation occurs that cannot be operated normally due to power outage or hardware failure. Economics refers to resilience as the 'resilience of economic recovery' and it is said to be strong when the economy returns to life immediately after a recession. In clothing textile, resilience refers to the ability of fibers to undergo deformation such as elongation, flexion, and compression due to the action of external forces, and to return to the original state when external forces are lost. The research on the resilience process has suggested several theoretical models focusing on the interaction process between the risk factors and the protective factors that affect resilience. The attributes of resilience consist of individual internal and environmental protection factors, which contribute to the adverse situation, reducing negative consequences and bringing about positive results (Lee & Lee, 2005: 11-14). Recently, resilience has been considered as an important component in the field of psychology, health and child education research. Because of the influence of positive psychology, we use the concept of resilience to theoretically conceptualize human adaptation (Lee, 2013: 260). In this context, resilience means the power to reduce negative emotion and promote adaptation, and the attribute of resilience is divided

into psychological dimension and social dimension. The psychological nature of the resilience was recognition of adversity, denial of negative emotions, giving positive values, hope, will of life, giving meaning, self-confidence, self-respect, problem-solving, determination and flexibility. Attributes in the social dimension were a sense of belonging and social support (Kim, 1998: 405).

Holling(1973), an ecologist who first introduced system-wide resilience, defined resilience as the capacity to sustain current status by absorbing the system sustainability and external changes. According to Holling(1973: 17), resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist. In this definition, resilience is the property of the system and persistence or probability of extinction is the result. Stability, on the other hand, is the ability of a system to return to an equilibrium state after a temporary disturbance[4] (Holling, 1973: 17). The more rapidly it returns, and with the least fluctuation, the more stable it is. In this definition, stability is the property of the system and the degree of fluctuation around specific states the result.

Disaster resilience has been described as the capacity of an actor, individual, community, social unit, organization, society or system to absorb, recover, cope, 'bounce back', mitigate, withstand or resist the impacts of hazards (Aldunce, *et. al.*, 2015: 3).

When applied to disasters, resilience can be defined as an affected area's ability to rebound after a catastrophic event. This would mean the return of lifeline infrastructures such as utilities, food and water, and shelter. In longer term, this would mean the return of households and businesses and a return to self-sufficiency and effective governance. A community's adaptability to change or adaptive capacity is strongly related to resilience (Carpenter, 2015: 290-291).

In discussing "resilience" referred to the ability of a community or city to overcome disasters, whether natural or technological. Resilience, a scientific term, has its origins in studies of ecological systems. Roughly, "resilience" means capacity of

Table 1. Terminologies related to system resilience

Term	Contents	Note
Vulnerability	-The human product of any physical exposure to a disaster that results in some degree of loss, combined with the human capacity to withstand, prepare for and recover from that same event -The relative degree of 'risk, susceptibility, resistance and resilience' to a hazard event or disaster	McEntire (2001)
Adaptive Capacity	-A significant factor in characterizing vulnerability -The extent to which a system can modify its circumstances to move to a less vulnerable condition	Luers, *et. al.* (2003: 259)
Resilience	-The overarching goal of a system to continue to function to the fullest possible extent in the face of stress to achieve its purpose, where resilience is a function of both the vulnerability of the system and its adaptive capacity	Holling (1973)

Source: Extracting from Dalziell & McManus(2004).

4) There is a core system to lead and operate the whole system. Core system can be defined as "a complex hub that lead and coordinates a whole system in a certain direction. There are several constituent elements which form a core system; value, institution, leadership, devotion, and expertise (Lee, 2014: 23; Lee, 2015: 4-5).

a general system to respond in a reversible manner to an acute or chronic stress so that it may return to its initial state (Harrison & Williams, 2016: 17).

Resilience can be defined as the ability to adapt and recover from confusion, stress, adversity, and change situations, although the differences are somewhat meaningful depending on the various fields and areas of research. In fact, resilience is the instinct of all living organisms, and it features risk and complexity as its adaptability to the environment (Jung, *et. al.*, 2016: 91).

The use of resilience as an outcome or a process also distinguished the research communities. Resilience is considered an outcome when defined as the ability to bounce back or cope with a hazard event and is embedded within vulnerability (Manyena, 2006). Process-related resilience is defined more in terms of continual learning and taking responsibility for making better decisions to improve the capacity to handle hazards. Determining whether resilience is an outcome or a process is an important step toward its application to disaster reduction (Cutter, *et. al.*, 2008: 600).

This various definitions of resilience can be made because it covers the overall human ability to adapt and cope with the environment (Hong, 2006: 48).

2. Disaster Resilience

The concept of resilience to disasters that occur in urban areas due to the phenomenon of urbanization with frequent meteorological changes and expansion of disasters around the world requires comprehensive consideration of local capabilities, including social and economic factors as well as physical concepts. The concept of resilience is connected with prevention, response, and recovery ability which has a great practical significance (UNISDR, 2012; Jung, *et. al.*, 2016: 93). In studies of disasters, resilience means the rate at which critical systems are restored after an earthquake or flood. Resilience is also referred to as "the flip side of vulnerability" because it emphasizes the ability of the system to cope with the risks and provides insights into what makes the system vulnerable (Lim & Lee, 2013: 21). Vulnerability can be divided into human vulnerability, social vulnerability, physical vulnerability, and ecological or environmental fragility (Ryu, *et. al.*, 2009: 22).

Resilience implies a concept that allows predicted disasters to be dealt with systematically, and that disasters that are not predicted by climate change minimize their damage, thereby reducing social chaos and allowing them to adapt and recover quickly (Shin, *et. al.*, 2014: 98). A global scope is increasingly important to consider because of the possibility that climate change may increase the severity of some disasters (e.g. flood, storm, and wild fire). Because any single facility has minimal influence on climate change but can still be greatly affected by the consequences of climate change, this aspect of the problem must be addressed through a unified, industry-wide approach (Rodriguez-Nikl, 2015: 161). Today's global society is now developing considerably in the economic and social area, and politiacl system with the universal value based on freedom and human right is now enlarging. Though, however, fundamental reform has been occurred after the end of the Cold War, global instability is more increasing than ever (Lee, 2014: 3).

According to Cutter, *et. al.*(2014: 65), disaster resilience enhances the ability of a community to prepare and plan for, absorb, recover from, and

more successfully adapt to actual or potential adverse events in a timely and efficient manner including the restoration and improvement of basic functions and structures.

This paper accepts the definition of Lee (2018: 77) that disaster resilience is the capacity of communities to make safer communities with greater safety than before the disaster, in the event of disasters that threaten the safety of the communities. In addition, it is necessary to include the concept of resilience to strengthen capacity to absorb and recover from disaster vulnerability. Therefore, disaster resilience is the capacity of communities to absorb and recover from disaster vulnerability through voluntary and cooperative activities.

In this context, the definition of disaster resilience should not only incorporate post-event consequences, but also pre-event preparedness and strategic planning (Zobel & Khansa, 2014: 83).

In this respect, the prevention of disasters can be said to be 'an activity that minimizes uncertainty before a disaster occurs and an activity that will lead to the next level of disaster response immediately if a disaster occurs' (Kim & Hong, 2017: 144).

One of the characteristics of so-called advanced country disaster management is that the loss of life is reduced while the cost of disaster damage is multiplied. In the United States, the federal government is urging the states and local governments responsible for primary disaster prevention and recovery to develop disaster prevention and mitigation plans[5]. Through land-use regulations, disaster resistant communities limit destructive development within the disaster-risk zone and induce development into safer areas. In addition, it is responsible for establishing and enforcing non-structural hazard mitigation plans such as reducing physical impact through strengthening of building codes for already-developed facilities. In addition, there may be little difference from other traditional ways of preventing and mitigating disasters in terms of providing safety education to raise awareness of disasters to local residents. However, local governments, profit-making organizations, non-profit organizations and ordinary citizens are participating in the decision-making and implementation process to prevent and mitigate disasters, and are striving to change the disaster culture of the entire community and reduce hazard vulnerability. In other words, the US is changing to a proactive disaster management model (Lee & Yang, 2005: 113).

In the Commonwealth of Australia, the National Partnership Agreement on Natural Disaster Resilience (NPA) was agreed to the parties and aimed to "enhance Australia's resilience to natural disasters through mitigation works, measures and related activities that contribute to safer, sustainable communities better able to withstand the effects of disasters, particularly those arising from the impact of climate change. The parties recognize they (a) "have a mutual interest in reducing the impacts, and increasing resilience to natural disasters"; and (b) "will work together and with other parties, such as volunteers, the private and non-government sectors and local government, to achieve those

5) Yang(2016: 147-151) emphasizes the importance of human capital, economic capital, social capital, and institutional capital to overcome disaster vulnerability and improve resilience. To improve the disaster resilience, it is inevitable to establish the legalized disaster response organizations and a variety of institution, culture, atmosphere, and trust (Hong & Lee, 2009: 156).

outcomes"(Aldunce, *et. al.*, 2015: 3).

The fundamental problem of Korea's disaster management is that it neglects its fundamental solution to the problem by focusing mainly on follow-up rather than prevention. In terms of follow-up response, connectivity between disaster management organizations and the lack of staff and budget for disaster management should be addressed. In the prevention, preparedness, response, and recovery processes, many budgetary measures should have been taken to prevent, mitigate, and learn, and a shift from government-centered disaster management to public-private and cooperative disaster management is needed. In terms of public service limitations, the government can no longer provide disaster management services on its own, and the role of the private sector to protect itself is important beyond the simple notion that the main body of national protection is the government (Kang, 2009: 804). In fact, the strengthening of resilience throughout society presupposes strengthening of social learning ability. Recovering or improving the state before the disaster cannot be achieved only by strengthening the administrative capacity of the government, but it should be based on strengthening the learning capacity of society as a whole. It also requires active participation in the civil society and the development of citizenship that recognizes social responsibility (Park, 2015: 93).

Every community has some resilience from disaster. This allows communities to recover from disaster damage and return to normality. However, it is common for most communities to repeatedly suffer human and property damage if another disaster of the same size occurs again. Thus, by strengthening disaster resilience capabilities, communities need to prevent, prepare, respond, and recover from disaster while avoiding the same disaster damage (Lee, 2018: 78).

3. Mitigation Strategy

In relation to disaster resilience, this paper defines mitigation strategies as 'disaster prevention activities that prevent the disaster itself from occurring through the voluntary efforts of the community and cooperative activities to minimize the damage even if a disaster occurs'. This resilience can be defined as the ability to mitigate the vulnerability of a community or individual to a disaster by reducing the likelihood of a disaster, as well as the ability to restore the system's ability to a pre-disaster level in the event of a disaster. Therefore, it is important to improve the community or individual's resilience so that disaster damage from the vulnerability can be minimized (Yang, 2016: 146).

The concept of resilience, which recognizes the inherent uncertainty in modern society and focuses on the ability to adapt to disease, risk, and stress, is emphasized in disaster management strategies. Disaster hazards arising from the interdependence of the technology systems seen in the major infrastructure of modern society are that the underlying nature of the social technology system in which we live should be viewed and adapted as a basic strategy (Park, 2015: 101).

In the mean time, the global community is suffering from rapid industrialization, urbanization, and global warming, and the effects of abnormal weather are skyrocketing. Now, in a globalized world, disasters such as typhoons, earthquakes,

tsunamis and volcanic eruptions are not limited to certain regions or countries, but are affecting the entire global community. In the past, large-scale disasters were considered to occur by accident and therefore treated as external variables for the system. In other words, disasters used to be statistical outliers, and studies on these were case-based. However, recently, research is also conducted from the perspective of resilience, recognizing that disaster is a complex phenomenon that exists in the system (Lim & Lee, 2013: 19-20).

Communities interacting with the environment develop resilience as a mechanism to control the inevitable disorder and conflict when exposed to external hazards. In a disaster situation, the system may cause the daily function to be totally or partially disrupted and may lead to a crisis of social order confusion or panic. The impact of a disaster on a community is not limited to material loss, but will amplify as much as it causes dysfunction and resource depletion in the interaction of the community and the environment (Rho, 2015: 149).

In particular, disaster resilience and mitigation strategies need to be explored together with the concept of vulnerability. Vulnerability is defined as the level of community susceptibility to disasters compared to the level of disaster resilience. Reducing the vulnerability of disasters is important for effective and timely restoration while minimizing disaster losses, since disasters themselves can not be completely prevented. Increasing disaster resilience can reduce the community's disaster sensitivity and disaster vulnerability (Choi, *et. al.*, 2017: 69).

Some policy scholars, such as Wildavsky(1988) in the late 20th century, argued that recovery strategies are more effective than preventive strategies if the crisis is difficult to predict and the response to the crisis is also unknown. A recovery strategy is more effective than a disaster prevention strategy if it is not possible to predict a crisis with chaos (Lim & Lee, 2013: 20). Since then, however, socio-economic analysis and planning have tended not to consider what is regarded as "abnormal situation" or "discontinuous situation". According to the concept of resilience, by considering these irrational and abnormal situations, it is within the scope of scientific interest. Therefore diversity may be more sustainable than efficiency, given all normal and abnormal conditions of the mid- to long-term (Jeon, 2015: 35-36).

In this paper, mitigation can be defined as measures taken before a disaster strikes with the objective of improving disaster resistance (Gilbert, 2010: 33). The primary intention of mitigation is to ensure that fewer communities and individuals become victims of disasters. The goal of mitigation is to create economically secure, socially stable, better built, and more environmentally sound communities that are out of harm's way (Haddow, *et. al.*, 2014: 74). The bulk of resilience comes through what are called mitigation efforts. There are two vital forms of disaster mitigation which are categorized as: structural and nonstructural mitigation (Phillips, 2016: 52). Structural mitigation includes the built environment, such as levees, dams, safe rooms, hurricane clamps on roofs, elevated buildings, retrofitted interiors, and hardened exteriors. Nonstructural mitigation measures include insurance, providing warning systems, educational programs, and planning. Mitigation measures represent one of the most important things

that a community can do to reduce disaster impacts. In many locales, mitigation planning can identify area hazards and appropriate mitigation measures in advance of disaster. In the case of technological disasters, mitigation can range from altering expectations and the choices of technology to preventing or lessening the consequences of a hazard (Cigler, 1988: 41).

Improvement of resilience is not based on a plan similar to the implementation of traditional disaster management policies based on planning and forecasting. The improvement of resilience should be made not only at the physical level of the social ecological system but also at the social organization, culture, and political level that can mobilize physical, human and economic resources. It is necessary to diversify the disaster management functions from concentrated central government to the local government and the private sector and strengthen the mutual cooperation network between these organizations to enhance the substitutability. Policies should be pursued to increase speed by enabling rapid distribution of information and accurate sharing of information between management agencies and private and government (Park, 2015: 108-109). The private sector may cooperate with the public sector because one or more of its subgoals may coincide with public sector purposes. Social and economic stability or a safe environment may be subgoals of portions of the private sector because they encourage investment (Ruchelman, 1988: 66).

Disaster has regional characteristics that are limited in time and space by the mechanism of occurrence. The nature of disasters and damage varies from region to region, so the area's ability to respond on-site is very important. In order to increase the effectiveness of the initial response, active participation of new partnership type is required not only in the strengthened ability of the local government but also in the whole area of disaster management, not the passive participation of the private organization. Therefore, it is necessary to form disaster management governance to enhance the ability of private organizations to participate in disaster management and to coordinate and cooperate with public and private sector organizations in order to promote efficient work between the government and the private sector (Ju, 2012: 298). In particular, in the case of natural disasters, where disaster occurrence cannot be prevented at source, it is possible to minimize the damage by improving resilience of individuals and communities. Moreover, climate change and social structure change simultaneously experience both natural and man-made disasters, requiring a shift from a government-led approach to sustainable disaster management paradigm to a community-based one. Thus, the role of the community in disaster management is becoming more important (Choi, *et. al.*, 2017: 85).

In addition, the active response to disasters by public institutions in disaster management starts from the awareness about the risks of disasters and the importance of effective disaster management. Effective disaster management requires each local government to actively collect and manage information from disaster management experts on local risk areas (Ju, 2012: 314).

In Germany, disaster prevention drills are carried out with major components which includes the policy advice for disaster management, guidance of education and training, guidance of senior policy

decision makers, and development of research projects for mitigation through disaster prevention (Han & Yoo, 2012: 151–152). The preparation period for training is usually 18 months, during which a number of discussions, conferences, agreements, preparation for seminars and workshops, and criteria for joint scenarios will be discussed. Also, scenarios for disaster prevention training are also developed in various forms. Large airports, for example, respond to the size of the airport in the event of a crisis in airport operations, and training participants include airport managers, air routes, federal and state police[6], customs and flight safety.

Ⅳ. SOME IMPLICATIONS FOR DISASTER MANAGEMENT

In the field of disaster management, it is required to change the paradigm of disaster management due to the increase of uncertainty and enormous diversification in disaster type. In particular, as it is impossible to prevent the occurrence of disasters, interest in resilience is increasing as a comprehensive disaster response paradigm for urban physical environment, individual and community (Shin, *et. al.*, 2014: 94).

The significant thing we can expect from the introduction of the concept of resilience is that the concept of resilience holds the potential of changing the paradigm of existing disaster management policies (Kang & Cho, 2013: 20). First, it shows the direction of a strategy to build capacity to become a safe society from disaster. Second, it includes a change from a perspective seen in the relationship between disasters and damage to a point of view within the categories of communities. Third, it provides a theoretical basis for comprehensively understand the social costs of disasters to society from the traditional way of understanding the social effects of disasters based on the amount of damage.

First, from a variety of perspectives, serious and in-depth cause analysis should be conducted to mitigate or minimize the likelihood of recurrence of the same type of disaster from past disasters. Given the post-disaster response, the government seems to see a national disaster as a result of a blind spot in regulations or systems (Han, 2018: 299). This raises the question of whether in-depth learning from the previous disaster cases. For example, the main response of the government was to include the roof in the scope of the building managers' responsibility for snow removal and ice removal, for damage caused by the roof of a gym collapsed by heavy snow. It is hard to say that the government has found a fundamental cause to alleviate the disaster.

Second, cooperation between disaster management agencies should be practically established. Today, the disaster is different from the fragmentary nature of the past and has a complex nature. When a fire occurs in an industrial complex, not only a simple fire suppression problem but also a toxic chemical leakage or toxic gas discharge leads to direct mass damage, as well as local air pollution, soil pollution, and drinking water pollution. Therefore, it is important to establish and operate a smooth

6) In the United States, it recognized the need to expand its role from policing activities focused only on crime prevention and response to disaster prevention and response activities after disasters such as 9/11 terror, Hurricane Katrina and the California earthquake. The scope of community police activities has expanded to include disaster management and crisis management (Lee & Shin, 2017: 319).

cooperation system between the government and other organizations, because not only government organizations but also external professional organizations and private parties share the role of disaster management.

Third, citizens, companies, and governments should make concerted efforts to establish safety culture (Lee, *et. al.*, 2006: 348). In areas where citizens are engaged in safety surveillance activities, companies must comply with safety regulations. In addition, the government needs to take responsibility for safety by enacting safety regulations, conducting continuous disaster management research and raising safety awareness through safety measures, and thoroughly inspecting the safety of multiple facilities.

Fourth, in order to effectively manage disasters, public officials should personally engage in responsible actions to prevent disasters and mitigate damage. In other words, external control of the bureaucracy is not enough to prevent various disasters. It is necessary to design an ethical environment in which elements such as personal attributes, organizational structure, culture, and social expectation can act together to secure accountability on the individual level of civil servants. It is important to consider pride as an expert, functional accountability assessed by peers, practical duties and utilization of social discourse (Yoo, 2015: 440; Cooper, 2012: 188-216).

Fifth, level of cooperation and opportunities for information exchange between public and private sectors should be increased, as should the central and local government officials responsible for disaster management, government officials with no experience in disasters, and public and private sectors. And measures should be taken to secure the expertise of government officials in charge of disaster management. According to the empirical study conducted by Kim & Moon(2015: 109-110), there is a need to broaden the opportunities for interactive dialogue and exchange of information on the realities and problems of disaster management in local governments. It has also been found necessary for civil servants with disaster experience to have a mechanism to share their experience with inexperienced officials or to provide opportunity to advise on diverse and complex disaster situations. In addition, the government should establish an organic link with local governments, military and fire agencies in the public sector as well as the general public and civil society organizations in the private sector. And it is also necessary to secure the professionalism and business continuity by reducing the number of civil servants of the disaster management officer and increasing the number of dedicated personnel.

Sixth, it is necessary to look at disasters not only in terms of response but also in terms of sustainability. The Korean government is increasing its reinstatement costs as it operates a budget for follow-up rather than a preventive or mitigation budget. This is an example of our society's perception of disaster management focused on follow-up or recovery rather than prevention (Lee & Yang, 2005: 123). In other words, budget input for disaster prevention and mitigation is recognized as a cost concept rather than an investment. Therefore, when budgeting for disaster prevention and mitigation, it is necessary to look at sustainable disaster management rather than just the concept of response.

Seventh, an academic analysis should be conducted to analyze the effects of disaster damage on individuals, households, and society. In Korea, natural disasters such as typhoons, floods, and earthquakes, as well as man-made disasters such as fires, collapse and explosions, and infectious diseases such as MERS, AI and SARS cause critical infrastructure disaster that paralyzes national facilities, systems and functions. Small to large scale natural disasters have affected societies around the world. Certainly the economics of natural disasters is a fairly recent branch of the economic research (Okuyama, 2007; Pelling, *et. al.*, 2002). The economics of natural disasters is highly intertwined with the study of the determinants of poverty and development where it investigates the effects of natural hazard on individuals, households and the overall economy (Lazzaroni & van Bergeijk, 2014: 333).

Eighth, citizens need to participate in social mourning rituals for victims in order to strengthen the community's resilience after a major disaster. After a major catastrophe, society and people are not easy to escape from the shock. The disintegrated society is gradually restored through rituals of mourning for which citizens participate extensively. In Korea, the number of citizens who participated in the social mourning for Ferry Sewol disaster was extremely high. This will make the pre and post disaster processes look calmer and collectively seek solutions, ultimately contributing to improve the resilience of society. On the other hand, the ritual of mourning which the state carried out in order to prevent the spread of social problems caused by Ferry Sewol disaster and to solve the crisis of governance did not help to strengthen social resilience (Lee, 2014: 69).

Ninth, we need to come up with measures to protect the vulnerable in times of disaster. Even when disasters of the same size occur, the weak such as the elderly, the disabled, children, the economically vulnerable and migrant workers can suffer more damage than ordinary citizens. Measures to protect the vulnerable could soon be taken to strengthen the community's resilience. Disaster resilience can be strengthened through the resources of civil society and local governments to which vulnerable disadvantaged persons belong. The vulnerability of the weak will occur at a personal level, at the community level and at the national level (Kim & Lee, 2018: 89-90). At the personal level, factors such as lack of economic ability, congenital or acquired diseases, instability in residential settings, characteristics of living environments, and age make them vulnerable to disasters. At the community level, factors such as the severance of communication between neighbors, the increase of single-person households, urbanization, and the widening gap between the rich and the poor affect the weakness. And at the national level, a lack of the legal system and disaster management system targeting the vulnerable, budget and resources, provision of one-sided welfare services, and poor delivery of disaster alert affect the weakness. In general, the weakness is often in a difficult situation to solve even individual factors, and are often overwhelmed with prevention and preparedness as well as responses to disasters.

V. CONCLUSION

The study of disaster resilience is limited and a few number of studies have been performed.

Although research on resilience itself has is new, studies that apply the concept of resilience to disaster management have begun to make it more aggressive and scientific. Applying the resilience concept to disaster and disaster management will enable us to extend the short-term and micro-disaster and disaster management issues to a long-term, macroscopic dimension. Traditionally, measures were prepared to analyze and manage the damage and effects of individual disasters over a certain period of time. However, by applying the concept of resilience, one can have a conceptual framework that recognizes the process emergence and complex disasters that lead to other disasters. It can also provide policy alternatives for the damage that the disaster will bring to the medium and long term. It is possible to establish measures to secure disaster resilience on the basis of the concept of sustainability.

In particular, if the local competitiveness that can improve the adaptability of the residents through measures and education about the characteristics of the region is increased, physical restoration to a state better than before the disaster can be possible. Resilience allows for predictable risk factors to be managed in advance to mitigate the underlying risks, minimize disruptions in the event of unforeseen disasters, and quickly recover in creating a safer society. Thus, it is emerging as a new disaster management paradigm in the era of climate change (Shin, *et. al.*, 2014: 103). Moreover, globalization and increased international cooperation have helped the world community to more effectively address risk reduction and limit the human impacts of disasters. Although the number of disasters has tripled since 1970s, the number of people worldwide who have perished has fallen by 50 percent (UNISDR, 2004). Greater recognition of the importance of emergency management and sustainable development is turning the tide on disasters. The efforts of the UN, the many non-governmental agencies involved in development and disaster preparedness and response, and the efforts of individual governments have shown that humans can effectively influence their vulnerability. There are several explanations for the falling fatality rates of disasters (UNISDR, 2004; Coppola, 2015: 23). These include ① more organized and comprehensive preparedness campaigns are helping individuals and communities to decrease their vulnerability and to react more appropriately in the face of disaster, ② early warning systems are giving potential victims more time to leave the dangerous situations associated with impending disasters, ③ special disaster-specific protection structures, such as tornado safe rooms, are mitigating the impact that disasters have on human life, ④ building code creation and enforcement are helping to increase the resilience of the various structures and systems upon which human depends.

This study aims to suggest some implications for preventing or mitigating the disaster hazards through examining the significance of disaster resilience. In order to achieve these research goals, some definitions were suggested. First, we defined disasters as events that cause massive damage to human life, property, and social communities. Second, disaster management is defined as the process of preventing and preparing disasters before they occur for the safety of human life, property, and community, and striving to respond and recover after disasters occur. Third, disaster resilience was viewed as 'the ability of the community to absorb

and recover from disaster vulnerabilities through voluntary and collaborative activities'. Fourth, mitigation was defined as measures taken before a disaster strikes with the objective of improving disaster resistance.

Based on this discussion, the following are the implications of disaster resilience for disaster management. First, serious and in-depth cause analysis should be conducted to mitigate or minimize the likelihood of recurrence of the same type of disaster from past disasters. Second, the cooperation between the disaster management institutions should be practically established. Third, citizens, companies and governments should make joint efforts to establish safety culture. Fourth, in order to effectively manage disasters, public officials should personally engage in responsible actions to prevent disasters and mitigate damage. Fifth, it is necessary to increase the level of cooperation and information exchange between the central and local governments responsible for disaster management, public officials with disaster experience and public officials without disaster experience, and public sector and private sector. In addition, measures should be taken to secure the expertise of government employees in charge of disaster management. Sixth, it is necessary to view disasters from a sustainability perspective as well as from a response perspective. Seventh, an academic analysis should be conducted to analyze the impact of the disaster on individuals, households and society. Eighth, citizens need to participate in social mourning rituals for victims in order to strengthen the community's resilience after a major disaster. Finally, we must prepare measures to protect the vulnerable in times of disaster.

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