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RESEARCH ON REGIONAL RESILIENCE IMPROVEMENT COPING WITH FLOODING DISASTER BY CLIMATE CHANGE EFFECT (II)

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KRIHS

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Main research reports are as follows :

- Research on Regional Resilience Improvement Coping with Flooding Disaster by Climate Change Effect (II), KRIHS, 2017
- Research on Regional Resilience Improvement Coping with Flooding Disaster by Climate Change Effect (I), KRIHS, 2016
- Resilience Strategies for Climate Change and Flooding: Knowledge Sharing, MOLIT, 2016
- The Study of Development Direction for Urban Policy to Intensify Urban Resilience Coped with Natural Disaster, MOLIT, 2015
- The Study for Developing of Flood Analysis Approach Considering Territory Changes, KRIHS, 2014
- A Study on Improvement of the Urban Flooding Disaster Prevention System coped with Climate Change, KRIHS, 2014
- Urban Design Technique Development Adapting to Climate Change Driven Heavy Rainfall Disaster, Korea Agency for Infrastructure Technology Advancement, 2011~2012
- Impact of humans on precipitation variability, climate and the water cycle (water sustainability), U.S. NASA, 2010

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Summary

Recently, the risk of mega flooding disaster has been increased by climate change and urbanization effect. In order to reduce the damage by flooding disaster, resilience concept has been introduced to disaster prevention field mainly in international organizations and advanced countries. The flooding damage by Typhoon Chaba in 2016 and Cheonan Power Exchange in 2017 showed that the risk of flooding disaster in Korea is increasing and that the flooding disaster could cause the Natech disaster. In this context, this research was conducted in collaboration with KRIHS(Korea Research Institute for Human Settlements) and the Woodrow Wilson Center in U.S., which has recently developed and operated resilience reinforcement research and policies.

This research was conducted as two years research. In the first year research, the resilience assessment method for disaster prevention field was developed and applied. The main goal of the second year research is to improve reinforcement of the urban resilience as the urban planning aspect. In this research, resilience is divided into the capacity for damage abatement and the capacity for damage recovery, based on the characteristics of resilience. This research present the problems and the direction of improvement of the current policy related with the capacity for damage abatement and recovery. Based on the direction of improvement of policy, the legal system improvement method is suggested. For the policy related with the capacity for damage abatement, the urban planning for disaster prevention and urban regeneration considering disaster prevention are selected and investigated for searching the problem of operation and suggesting the improvement method. Now, in Korea, the policy related with the capacity for damage recovery is not actively settled yet, so this paper suggest the direction of Korea's introduction of related systems, based on the overseas cases. For the policy related with the capacity for damage recovery, the transportation planning considering disaster prevention and PDRP(Pre-Disaster Recovery Plan) in U.S. are selected.

There are four major policy suggestions in this research; 1) It is necessary to make flood risk data which can be widely used in various resilience strengthening policies. In order to make flood risk data, it is necessary to improve current disaster vulnerability assessment method; 2) Promotion of cooperation with governmental department for implementation of resilience strengthening policy in the 2nd National Climate Change Adaptation Measures currently in operation; 3) Introduced related policy such as the transportation planning considering disaster prevention and PDRP to enhance the capacity for damage recovery that Korea currently does not consider; 4) To institutionalize the resilience assessment method and conduct continuous monitoring and establish the guideline for strengthening local customized resilience.

Furthermore, in this research, the measures to improve the related legislation in urban and disaster prevention, urban regeneration and the transportation field are proposed for reinforcing the effectiveness of the resilience strengthening policy.

CHAPTER I.

Resilience Improvement Measures for Climate Change-related Flood Disaster Response II

1. Research Overview

1.1 Research Background

The risk posed by natural disasters has recently intensified due to the effects of climate change, urbanization, and other factors. In Korea's case, flooding associated with heavy rainfalls , typhoons, and other sources accounts for over 90% of all natural disaster-related damages. As disasters increase in scale, they stand a greater likelihood of developing into Natech (natural disaster-triggered technological disasters), with impacts that extend to the modern city and its complex connectivity. The term "Natech " refers to a technological disaster caused by a natural disaster, representing a complex form of disaster resulting from the combination of natural and technological disasters (Oh, 2013).

The United States has experienced frequent instances of major regional damages resulting from large-scale natural disasters such as Hurricane Katrina in 2005, Hurricane Sandy in 2012, and Hurricanes Irma and Harvey in 2017. In Korea's case, Typhoon Chaba in 2016 caused damages to Hyundai Motor's plant in Ulsan and other industrial complexes. This has triggered a growing sense of alarm that the effects of flooding could extend beyond inundation damages to affect local economies.

Amid the increasing likelihood of natural disasters occurring as a result of climate change and urbanization—and a growing awareness that the damages from such disasters might not be limited to single regions, but could cause immense damages through their linkage to the economic structure—adoption of the resilience concept has become a trend in the disaster prevention field. Within that field, resilience has been defined as

a “comprehensive disaster prevention concept that takes into account all stages of the disaster response process (prevention, preparation, response, and recovery) to strength the sustainability of urban systems in response to the uncertainties associated with a changing environment (possibility of natural disaster occurring)” (Han et al., 2015). Because the resilience concept presumes the possibility of damages resulting from disasters that exceed the capacities of disaster prevention facilities it also underscores the need to use not only said facilities but also urban planning elements and other elements that have not been considered as part of disaster prevention measures in order to boost the resilience of cities themselves.

In the US, various disaster prevention policies incorporating the resilience concept have been developed and implemented in the wake of massive and uncontrollable natural disasters such as Hurricane Katrina in 2005 and Hurricane Sandy in 2012, including the National Disaster Recovery Framework (NDRF) and pre-disaster recovery plans (PDRP). International organizations have also implemented various policies and campaigns incorporating the resilience concept. UN-ISDR has carried out the Making Cities Resilient (MCR) campaign and developed the “Local Government Self-assessment Tool for Disaster Resilience” (LG-SAT) to certify international resilient cities. LG-SAT emphasizes the importance not only of disaster prevention facilities, but of urban planning measures, disaster prevention organization capacities and budgeting, and community involvement as well, with ten scorecards distributed to assess them.

Since the Umyeonsan Mountain landslide in 2011, Korea has been executing disaster-prevention urban planning policies as part of a shift from disaster prevention facilities-dependent policies to ones that also incorporate various urban planning elements to increase cities’ own disaster prevention capacities. Korea has experienced a greater degree of urbanization than other countries of the world, and the fast rate of climate change has resulted in a strong likelihood of large-scale flood disasters occurring (Han et al. 2016). To improve Korea’s disaster prevention policies amid this great likelihood of large-scale flood disasters, the Korea Research Institute for Human Settlements (KRIHS) signed a 2014 memorandum of understanding (MoU) for international joint research with the Woodrow Wilson Center (WWC) in the US. Three joint studies have been carried out under KRIHS’s supervision with the cooperation of the Korea Environment Institute (KEI) and WWC, Virginia Tech, the Metropolitan Research Institute, and the University of Maryland in the US.

This study, in particular the fourth joint research, was second annual project of “Resilience Improvement Measures for Climate Change-Related Flood Disaster Response.” For the first year, a resilience assessment methodology suited to the Korean situation was developed . The current study, which represents the second year of the effort, offers directions for achieving resilient cities through increased damage abatement and recovery capacities. Table 1 shows an overview of the joint research efforts carried out by KRIHS and WWC.

Table 1. The Study of Development Direction for Urban Policy to Intensify Urban Resilience cope with Natural Disaster (2015)

Project Type	Details	
Commissioned Project	Study Title	The Study of Development Direction for Urban Policy to Intensify Urban Resilience Cope with Natural Disaster
	Study Period	January 28, 2015–July 26, 2015
	Chief Content	Identify avenues to reflect the resilience concept in urban policy to build cities that are safe from natural disasters that have increased in scale and rate due to climate change
	Research Organizations	KRIHS, WWC, Virginia Tech, University of Maryland
	Major Outcomes	· International seminar held (February 23, 2015, Washington, DC) · Simultaneous World Water Forum event (April 14, 2015, Daegu, Korea) · Proposal submitted for joint National Research Council for Economics, Humanities and Social Sciences project · KRIHS Special Report #26 published ("Research on Urban Policy Development for Urban Resilience Reinforcement")
Commissioned Project	Study Title	The Study of Improvement Plan with Strategy of Resilience response to Flooding by Climate Change and Knowledge Sharing (2016)
	Study Period	April 20, 2016–October 16, 2016
	Chief Content	Developing measures to increase city resilience in response to flooding and other climate change-related disasters and to share examples of Korean urban policies in developing countries and elsewhere overseas
	Research Organizations	KRIHS, WWC, Virginia Tech, Metropolitan Research Institute
	Major Outcome	· Resilience concept incorporated into city/county management plan formulation guidelines
Basic Project	Study Title	Research on Regional Resilience Improvement coping with Flooding Disaster by Climate Change Effect (I) (Development and application of resilience assessment methods)
	Study Period	January 1, 2016–December 31, 2016
	Chief Content	Developing local resilience assessment methodology in connection with flood disasters
	Research Organizations	KRIHS, KEI, WWC, Virginia Tech, Metropolitan Research Institute
	Major Outcomes	· International seminar held (October 31, 2016, Washington, DC) · WWC online brief published (May 2017) · Awarded WWC commendation for outstanding research (July 2017) · KRIHS Special Report published and posted on WWC website (August 2017)
Basic Project	Study Title	Research on Regional Resilience Improvement coping with Flooding Disaster by Climate Change Effect (II)
	Study Period	January 1, 2017–December 31, 2017
	Chief Content	Presenting avenues for achieving resilient cities through increased damage abatement and recovery capacities
	Research Organizations	KRIHS, WWC
	Major Outcomes	· Guidelines on Assessment of Cities' Vulnerability to Climate Change-Related Natural Disasters and Its Use partially amended (May 2017) · International seminar held (November 28, 2017, Washington, DC)

1.2 Research Goals

This study took the form of a two-year international joint research effort with the Woodrow Wilson Center (WWC) in the U.S. The research focus during the first year was on resilience assessment methodology development and application, while the research purpose during the second year (addressed in this report) was on presenting avenues for achieving resilient cities through greater damage abatement and recovery capacities.

Due to a trend of natural disasters increasing in scale, the resilience concept has been introduced in the field of disaster prevention. Within that field, the resilience concept emphasizes increased regional disaster response capacity, which include disaster prevention organization capacity and budgeting and community involvement, among other areas. In particular, the emphasis in increased resilience is on transcending the limitations of current disaster prevention facilities-dependent policies and taking advantage of urban planning elements to increase cities' own disaster response capacity.

During the first year of the study, a methodology was developed to assess resilience as local capacities across all stages of disaster response, taking into account regional climate and physical disaster vulnerability. The resilience assessment methodology reflected both management targets reflecting specific local vulnerabilities (vulnerable area, Urban infrastructure, vulnerable citizens, and buildings) and assessment targets reflecting the constituent elements of local disaster response capacity (organizations, budget, and public participation), and resilience at the national level and individual local government level was assessed and analyzed, with avenues presented for increasing resilience. To increase the policy effectiveness of resilience assessment, it proposed an approach of using the disaster vulnerability assessment methods currently employed by the Ministry of Land, Infrastructure and Transport (MOLIT) for management target analysis, while employing data from Ministry of the Interior and Safety (MOIS) examination of disaster management condition in local government (EDMC-LG)for assessment target analysis. As a policy approach, it also proposed linking and employing the two current policies to conduct ongoing assessments and monitoring of resilience. For the first-year study, Korea's disaster prevention policies were compared with the subcategories in UN-ISDR's LG-SAT, which is considered a leading assessment methodology. The results showed Korea's disaster prevention policies to be lacking in terms of resilience improvement measures employing urban planning elements; areas reflecting and assessing these were also found to be lacking in EDMC-LG.

In consideration of this, the second-year study had the aim of presenting avenues for achieving resilient cities by making use of urban planning elements. Within the disaster prevention field, the concept of resilience refers not only to minimizing shocks and reducing damages before disaster occurs and responding swiftly after it occurs, but also to preparing for possible future disasters through a recovery process that takes prevention into account. In view of this aspect of resilience, capacities were categorized into damage abatement capacity before disaster occurs and damage recovery capacity after disaster occurs. This study suggests avenues for achieving resilient cities through improvements to policies for the strengthening of damage abatement and recovery capacities and directions for their adoption.

CHAPTER II.

Trends in Resilience Policies and the "Resilient City" Concept

1. Overseas Trends in Resilience Strengthening Policies for Disaster Prevention

The concept of resilience is increasingly being actively adopted in the field of disaster prevention, particularly by international organizations and advanced countries A leading example of an international organization is the United Nations, which has emphasized the resilience concept in disaster prevention for the sake of sustainability; examples of private groups include the Rockefeller Foundation.

The concept of resilience in disaster prevention as a means of strengthening city sustainability was discussed at the UN Habitat III (UN Conference on Housing and Sustainable Urban Development) in Quito, Ecuador, in October 2016. The first UN Habitat meeting (held in Vancouver, Canada, in 1976) focused on improving urban poverty, inequality, and urban slums and other poor residential environments, while the second (Istanbul, 1996) emphasized the need to guarantee suitable residential environments and accept residential rights as human rights (Ha 2016). The chief focus of the third meeting in 2016 was "the right to the city and cities for all." Ahead of the development of an urban agenda at UN Habitat III, the Habitat secretariat had begun in 2014 to request the submission of national reports on urban development and urban issues from governments around the world; these were used as a basis for drafting 22 total issue papers in six areas. Beginning in 2015, experts were invited from around the world to write ten policy papers for ten selected policy units. These covered a diverse range of fields spanning social integration and equality to cities, housing, and basic services; areas related to resilience in particular were discussed in depth in the city resilience section of issue paper 15 and the urban ecosystem and resilience section of issue paper 8.

The Making Cities Resilient (MCR) campaign under the UN's International Strategy for Disaster Reduction (UN-ISDR) focuses not only on traditional disaster reduction approaches through disaster prevention facilities, but also on the importance of increasing cities' resilience through various urban measures. In particular, UN-ISDR has developed LG-SAT as a tool for assessing regions' disaster prevention capacity and certifying "safe cities." Although it is a private group rather than an international organization, the Rockefeller Foundation in the US has been carrying out the Asian Cities Climate Change Resilience Network (ACCCRN) project since 2008. Recently, it has provided budgetary support through a project to select "100 Resilient Cities" as a means of strengthening cities' resilience against the possibility of large-scale natural disasters stemming from climate change.

In the US, various policies to increase resilience have been developed and introduced after the devastation associated with Hurricane Katrina in 2005. To begin with, the National Response Plan (NRP) that the country had maintained prior to Katrina was overhauled in 2008 into a National Response Framework (NRF), and an additional National Disaster Recovery Framework (NDRF) was introduced to incorporate the resilience concept. The Federal Emergency Management Agency (FEMA) established guidelines for state governments (2016) and local governments (2017) to formulate Pre -Disaster Recovery Plans (PDRPs) for effective recovery measures in the event of a natural disaster. While it is not the chief agency for disaster management, the Department of Housing and Urban Development (HUD), recognizing the importance of increased resilience within cities for disaster prevention , has developed and implemented various measures to encourage local governments to build their resilience, including the $1 Billion National Disaster Resilience Competition in 2014 and the Rebuild by Design project.

As seen above, international organizations and advanced countries that have experienced large-scale damages from disasters have led the way in shifting from traditional disaster prevention approaches reliant on disaster prevention facilities toward policies that encourage the building of cities' resilience in the face of possible natural disasters through urban planning, stronger local government disaster prevention capacity, and greater community and local government involvement.

"**In the US, various policies to increase resilience have been developed and introduced after the devastation associated with Hurricane Katrina in 2005.**"

2. Trends in Disaster Prevention Policies for Korean Cities

Korea's disaster prevention policies have traditionally been focused chiefly on structural measures, including disaster prevention facilities. A leading example of this is the disaster prevention effort carried out by the Ministry of the Interior and Safety (MOIS), through which approximately 6,960 billion KRW in state money was invested between 1995 and 2016 in disaster risk zones (disaster-susceptible regions, dangerous reservoirs, densely populated zones, and sharp acclivities), small rivers, and rainwater retention infrastructure, resulting in roughly 1,105 out of the 1,963 natural disaster risk improvement zones having their designations removed. Structural measures are certainly a priority for regions that are vulnerable to disaster, but disaster prevention capacity are strengthened all the more when disaster prevention facilities are linked to the various elements of cities.

Since the Umyeonsan Mountain landslide in 2011, Korea has combined its traditional disaster prevention facilities -dependent disaster prevention measures with analyses of cities' vulnerability to disasters associated with climate change, while formulating urban planning policies for disaster prevention that involve drafting disaster prevention measures incorporating both disaster prevention facilities and urban planning elements. In 2011, a provision was added to the urban planning guidelines requiring that vulnerability to climate change-related disaster be analyzed first prior to urban plan development. In 2015, Articles 20 and 27 of the Land Use Regulations at the National Territory Plan and Use Act were amended to mandate disaster vulnerability assessment when formulating urban plans. Enacted in 2016, the Guidelines on City Climate Change-Related Disaster Vulnerability Assessment and Its Use presented a standardized disaster vulnerability assessment methodology for use in the development of urban planning for disaster prevention incorporating the city resilience concept. In 2016, the resilience concept was introduced for the first time in the "Guidelines for City/County Management Plan Formulation," with a passage included in Section 6 (Landscape and Safety Planning) mandating "prevention and preparation through damage-reducing land usage and infrastructure positioning and planning to increase the sustainability of urban systems toward natural disasters that have been increasing in scale as a result of climate change and urbanization," along with "formulation [of management plans] that takes into account the city resilience concept, including swift response and damage recovery."

To strengthen the linkage between urban planning for disaster prevention and existing disaster prevention measures, the land use regulations at the national territory plan and use act were amended in 2012 to encourage the incorporation of a comprehensive plan for storm and flood damage reduction into urban plans. In 2016, the enforcement decree for the Countermeasures against Natural Disasters Act was amended to increase the linkage between disaster prevention and urban planning.

As this shows, the trend in Korea's disaster prevention policies has been one of development away from the traditional reliance on disaster prevention facilities toward a new form with a stronger linkage between existing disaster prevention measures and urban planning, along with the recent incorporation of the resilience concept.

3. The Resilient City Concept

To summarize what has been discussed so far, disasters have increased in scale due to factors including climate change and urbanization, and the increasing likelihood of disasters occurring has resulted in a shift in the disaster prevention paradigm from its existing focus on disaster prevention facilities and "resistance" to disasters to a new form that emphasizes disaster prevention measures and disaster response and recovery capacities in conjunction with various other measures, including those related to urban planning. The concept of resilience as currently adopted in the disaster prevention field may be defined as the ability to absorb the damages of whatever natural disasters may occur and to recover and adapt quickly.

As the resilience concept has been adopted in the field of disaster prevention, international organizations and others have begun formulating definitions of "resilient cities." Resilient cities share aspects that help them mitigate and adapt to shocks, which strengthens their sustainability. A resilient city may therefore be defined as a city that boosts its resilience for the sake of greater sustainability as a city.

Table 2. Definitions of 'Resilient City'

Institution	Definition
Rockefeller Foundation	The capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kind of chronic stresses and acute shocks they experience
UN-ISDR	The ability of a system, community, or society exposed to hazards to resist, absorb, accommodate, adapt to, transform, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management
UNU-CPR	The ability to activate protective qualities and processes at the individual, community, institutional, and systems level to engage with hazards or stressors and cooperate with each other in order to maintain or recover functionality and prosper while adapting to a new equilibrium and minimizing the accumulation of preexisting or additional risks and vulnerabilities
UN ESCAP	A city with the ability to withstand, adapt to, and recover from natural disasters and major economic crises

Sources: Adapted from Rockefeller Foundation homepage,[01] UN-ISDR (2012), UNU-CPR homepage,[02] and UN ESCAP homepage[03]

01. https://www.rockefellerfoundation.org/our-work/initiatives/100-resilient-cities/ (accessed on September 11, 2017)
02. https://cpr.unu.edu/defining-the-resilient-city.html (accessed on September 11, 2017)
03. http://www.unescap.org/our-work/ict-disaster-risk-reduction/building- resilience-disasters/about (accessed on September 11, 2017)

Approaches to improving resilience may be generally divided into structural and nonstructural measures. Nonstructural measures include improvements to the capacity of organizations performing disaster prevention duties, budgeting for disaster prevention and executing related efforts, and encouraging community involvement. Because these nonstructural measures are relatively susceptible to being undermined by factors such as the level of commitment by related institutions and budgeting issues, the first-year study involved developing a resilience assessment methodology linked to regional disaster vulnerability, with an emphasis on the importance of ongoing monitoring.

Structural measures, especially those involving disaster prevention facilities, are focused on the design and establishment of said facilities based on long-term climate data for specific regions; for this reason, a resilience assessment methodology for structural measures was not included in the first-year study. The Korean Ministry of the Interior and Safety (MOIS) is currently implementing policy measures to re-establish regional disaster prevention performance targets in order to upgrade infrastructure design standards in consideration of climate change and other factors. The first-year study findings also included a comparison with resilience-related policies overseas, which showed Korea's disaster prevention policies to be highly dependent on disaster prevention facilities in terms of structural measures, while lacking in measures related to urban planning. As resilience is predicated on the possibility of disasters occurring, not only disaster facilities but the resilience of cities themselves must be bolstered to mitigate shocks in the event of such a disaster, and the development of urban planning measures is a critical part of shock mitigation.

Resilience may be divided into the ability to absorb shocks before damage occurs and the ability to respond, recover, and adapt swiftly. For the purposes of this study, damage abatement capacity is defined as the ability to reduce damage by absorbing shocks before damage occurs, and damage recovery capacity as the ability to respond, recover, and adapt swiftly.

Among existing disaster prevention policies, structural measures consist for the most part of policies that use disaster prevention facilities to increase damage abatement capacity. Since 2011, however, urban planning policies for disaster prevention have been introduced that combine urban planning measures with disaster prevention facilities. In terms of previously developed urban disaster prevention facilities, facilities such as draining systems and embankments have been designed and built based on long-term climate data, and are therefore highly vulnerable to variations associated with climate change and urbanization. At the same time, it is extremely expensive and time-consuming for densely developed urban areas to implement measures such as the rebuilding of disaster prevention facilities. In reflection of this fact, the Guidelines for Urban Regeneration Strategy Plan Development have recommended since 2014 that basic disaster surveys and urban regeneration projects for disaster-susceptible regions be carried out in conjunction with urban regeneration efforts for the redevelopment of depressed neighborhoods. Urban planning for disaster prevention and urban regeneration considering disaster prevention could be viewed as leading examples of policies to bolster damage abatement capacity beyond the existing disaster prevention facilities-dependent structural measures due to the effects of recent examples of urban flooding. In consideration of this, research on damage abatement capacity was focused on current examples of the establishment and implementation of urban planning for disaster prevention and urban regeneration considering disaster prevention.

Damage recovery capacity represents the ability to swiftly respond, recover, and adapt after a disaster occurs. In existing disaster prevention policies, the focus in terms of swift response and recovery is chiefly on nonstructural measures involving personnel, support equipment, and supplies, with an emphasis less on adaptation than on simple restoration of the status quo or the building of additional disaster prevention facilities. In other words, Korea's current disaster prevention policies are lacking in structural measures aimed at improving disaster recovery capacity that incorporates urban planning elements in addition to disaster prevention facilities. Recognizing the importance of roads in a swift disaster response, the MOIS has recently carried out policy research in connection with emergency transportation routes and other "disaster prevention roads," while working to develop measures to incorporate these roads into policy (Lee, 2016). In terms of the adaption element of damage recovery capacity, guidelines for preliminary recovery planning that take disaster prevention into account during recovery efforts have been developed in the US, which has introduced pioneering examples of resilience-related policies. In consideration of this, the avenues suggested for improving resilience in terms of damage recovery capacity focus on pre- disaster recovery plan and transportation planning that takes disaster prevention into account.

“In terms of the adaption element of damage recovery capacity, guidelines for preliminary recovery planning that take disaster prevention into account during recovery efforts have been developed in the US, which has introduced pioneering examples of resilience-related policies.”

CHAPTER III.

Current Damage Abatement Capacity Policies and Avenues for Improvement

1. Urban Planning for Disaster Prevention in Korea

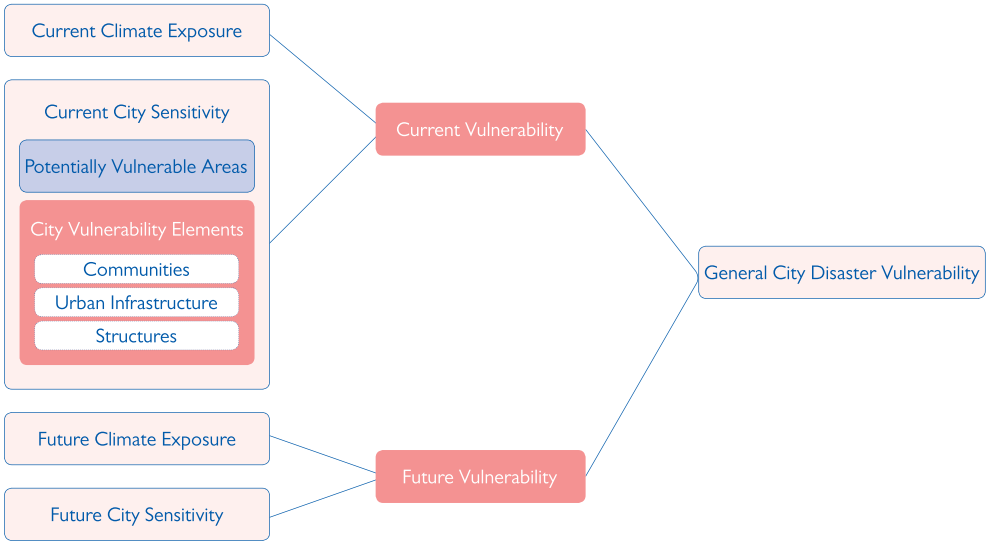
In Korea, urban planning policies for disaster prevention combining existing disaster prevention measures with urban planning strategies have been developed and introduced in the wake of the Umyeonsan Mountain landslide in 2011. Urban planning for disaster prevention first involves analysis of disaster-susceptible regions, which is used to develop urban disaster prevention plans for said regions that incorporate the reinforcement of infrastructure (structural measures), urban planning strategies (e.g., land use , infrastructure, and permits for development activities), and response systems (insurance and evacuation), as well as damage abatement (prevention) plans to develop cities that are safe from disasters.

In 2016, the Guidelines on City Climate Change-Related Disaster Vulnerability Assessment and Its Use were established based on Articles 20 and 27 of the land use regulations at the national territory plan and use act following its 2015 amendment. The disaster vulnerability assessment guidelines include content on general principles for disaster vulnerability assessments, indicators and investigation methods, examination of findings, usage, and support systems. The findings of disaster vulnerability assessments are used as basic data for making prior determinations on vulnerable areas in cities and countries and developing urban planning for disaster prevention when formulating or altering basic city and county plans.

No separate guidelines currently exist for the formulation of urban planning for disaster prevention, and the direction for their development is based on disaster prevention zone guidelines established in 2014 by the Ministry of Land, Infrastructure and Transport (MOLIT). As the institution in charge of examining disaster vulnerability assessment findings, KRIHS not only inspects the results of local government analysis but also provides regular instruction to local government officials and engineering staff.

The disaster vulnerability assessments that are used to provide basic data when formulating urban planning for disaster prevention focus on six disaster types (heavy rainfalls , heat waves, heavy snowfall, heavy winds, droughts, and sea level rising). Analyses retain the framework of the IPCC climate change disaster vulnerability assessment (2007), while using relative evaluations of analysis targets (within local governments) to identify disaster-susceptible regions (classified according to four levels) in light of climate exposure and city sensitivity. In more detailed terms, current vulnerability is analyzed in terms of current climate exposure and city sensitivity (a combination of potentially vulnerable regions and city vulnerability elements), while future vulnerability is analyzed in terms of future climate exposure according to climate change scenarios and city sensitivity as a reflection of the future urban development outlook, among other factors. General findings for a city's disaster vulnerability are first identified as a combination of current and future vulnerability; the results of on-site studies and expert opinions are then reflected to establish the final general disaster vulnerability assessment findings for the city in question.

Figure 1. Disaster Vulnerability Assessment Structure



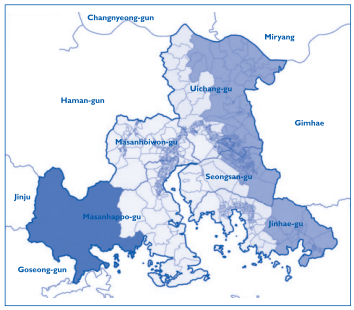
Source: MOLIT, 2017. "Guidelines on City Climate Change-related Disaster Vulnerability Assessments and Their Use," p. 9.

The spatial unit for disaster vulnerability assessments is the population census aggregation district,[04] with a spatial scale equivalent to 1/23 the size of the town/township/neighborhood. Indicators used for disaster vulnerability assessment consist of spatial data capable of showing climate and vulnerability for the various forms of disaster; when conducting an analysis of current and future vulnerability and general city disaster vulnerability, levels are assigned through the use of a level matrix and overlapping data for each space.

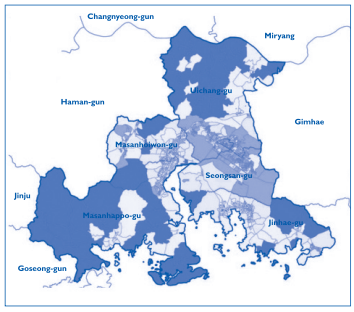
04. An aggregation district is a spatial unit consisting of 500 residents used during a population census, with assignment based on semi-permanent land features such as surrounding roadways, rivers/streams, railways, and mountain ridges.

Figure 2. Level Matrix and Sample Vulnerability Assessment Result

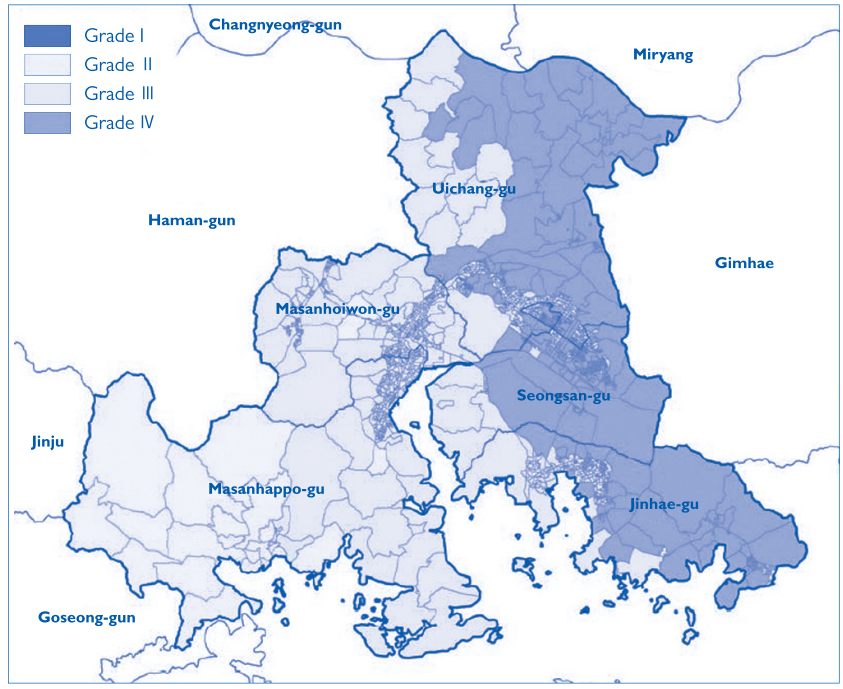
Future Climate Exposure	I	I	I	I	II	II	II	II	III	III	III	III	IV	IV	IV	IV
Future City Sensitivity	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Future Vulnerability	I	II	II	III	II	II	III	III	II	III	III	IV	III	III	IV	IV



Future climate exposure



Future city sensitivity



Future vulnerability

Sources: 2017 Urban Climate Change Disaster Vulnerability Study (KRIHS)

2. Urban Regeneration Considering Disaster Prevention

Urban regeneration involves the outlining of intermediate and long-term visions for declining cities and is executed through a comprehensive plan in which the regeneration efforts distributed across multiple agencies are integrated and coordinated. Urban regeneration plans consist broadly of basic national urban regeneration guidelines, urban regeneration strategic plans, and urban regeneration performance plans.

According to the current guidelines of urban regeneration strategic plan formulation (enacted on June 23, 2014), disaster vulnerability is to be considered as a category in the basic studies (general conditions, urban potential, etc.) performed when formulating an urban regeneration strategic plan. Examinations of disaster-vulnerable regions, including frequently inundated regions and areas affected by frequent landslides, are to be included under the land usage category for general conditions, with a recommendation that urban regeneration strategic plans be formulated to grasp these urban risk factors in a way that permits planning for both urban regeneration and safety. In addition to neighborhoods in a serious state of decline, regions with high risks of flooding, fires, and other disasters are also included as areas deemed to urgently require state-level proactive maintenance and environmental improvement measures within the various standards used to designate urban regeneration and generational zones when formulating an urban regeneration strategic plan. As a result, regions with a high disaster risk may also be designated as urban regeneration and revitalization zones.[05]

05. An "urban regeneration and revitalization region" is a candidate region for strategic measures to maximize the effects of urban regeneration efforts through the focused channeling of state and local government resources and capacities. The category includes regions whose designation and removal thereof is determined through urban regeneration strategic plans and regions designated as urban regeneration "pioneering zones" (Article 2.1.5).

Given the haphazard development of low-lying urban regions and hillside villages during Korea's rapid urbanization process, declining regions are more likely to be exposed to flooding and landslide risks. For this reason, the current guidelines suggest the application of "high disaster risk" as a standard when designating zones for urban regeneration and revitalization. Urban regeneration may offer a prime opportunity to develop local communities into disaster-safe and highly resilient environments in conjunction with disaster-vulnerable region servicing, application of Low Impact Development methods, and other disaster reduction measures. In reality, however, there have been few if any cases of urban regeneration and revitalization designations for highly disaster-vulnerable regions being used an opportunity to reduce disaster risk and otherwise improve damage abatement capacity.

While disaster prevention has received little consideration in urban regeneration efforts to date, the Korean government has established plans to actively carry out disaster zone regeneration efforts in connection with its "urban regeneration New Deal" effort in the wake of recent earthquake activity.

At approximately 2:29 p.m. on November 15, 2017, a magnitude 5.4 earthquake occurred in Namsong-ri, a village in the Heunghae-eup of Pohang, Gyeongsangbuk-do. The Pohang earthquake was the second largest (after the Gyeongju earthquake in 2016) since earthquake observation was first conducted in Korea in 1978, and resulted in 92 injuries and KRW 55.1 billion in property damage (Korea Meteorological Administration homepage). With the Pohang earthquake occurring not long after the 2016 earthquake in Gyeongju, the Korean public's earthquake fears have been growing.

In the wake of the Pohang earthquake, the National Assembly voted on March 30, 2018, to amend the Special Act on Urban Regeneration to establish a new "special regeneration region" system to support urban regeneration projects in disaster-affected regions. The government included regions of Pohang that suffered heavy damage in the earthquake as special disaster regions to receive active support. Efforts are currently under way to streamline the procedures to allow for faster project execution, including "special urban regeneration zone" (title subject to change) designation for regions proclaimed as special disaster areas that are also designated as special regeneration zones and simultaneous procedures for plan formulation and region designation. The main content of the disaster region urban regeneration New Deal effort is slated to include supplies of public infrastructure and conveniences, residential support, support for stores and factories, job creation assistance, and the establishment of regional tourist attractions.

3. Avenues for Improvement: Damage Abatement Capacity Development Policies

3.1 Improving Urban Planning for Disaster Prevention

This chapter has examined urban planning for disaster prevention and urban regeneration considering disaster prevention that have been carried out in Korea in connection with cities' damage abatement capacities. Since the Umyeonsan Mountain landslide in 2011, a shift has been under way in Korea from disaster facilities-dependent prevention policies to urban disaster prevention measures that consider urban planning and other areas. Perhaps the most representative instance of this is the formulation of urban planning for disaster prevention based on disaster vulnerability assessments. Recently, there has been a trend of increasing the linkage between disaster prevention and city-related planning by improving laws and institutions related to disaster preventions and cities for the simpler formulation of urban planning for disaster prevention. Based on the information examined in this chapter, problem areas with the implementation of urban planning for disaster prevention include linkage and usage issues stemming from a lack of correspondence in the spatial data currently employed for disaster prevention and urban planning; limits to formulation of urban planning measures; and failure to establish an adequate system for smooth cooperation among related government agencies.

While related disaster prevention policies have been introduced overseas in the name of urban planning for disaster prevention, implications have been identified through an investigation of measures combining disaster prevention facilities with urban planning policies, which are similar in nature to urban planning for disaster prevention. The overseas examples studied were those of Japan and the United Kingdom, which suffer frequent large-scale flood damages, and the Netherlands, which is threatened with climate change-influenced flooding due to a large portion of the country lying below sea level. Japan, where flooding frequently occurs as a result of climate and topography

factors, was relatively early in establishing disaster prevention measures combining traditional disaster prevention facilities with urban planning measures. In particular, it has established solid inter-agency cooperation with the enactment of the Urban River Inundation Damage Countermeasure Act as a reflection of the disaster susceptibility of urban regions. In the United Kingdom, flood-safe urban plans have been formulated through the performance of strategic flood risk assessments during urban development to rate regions' flooding vulnerability and the use of graduated and exceptional examination methods that assign land usage differentially according to facilities and uses. The Netherlands has established a water plan at the national level, which serves as the basis for the pan-governmental Delta Project. Recognizing the importance of urban planning measures, the Netherlands Environmental Assessment Agency emphasized the need for spatial adaptation in its recently published *Delta Project 2018*, while offering spatial adaptation strategies for different spatial units.

In advanced countries with a high disaster risk, awareness of the importance of urban planning measures in addition to disaster prevention facilities has led to the formulation of systematic urban planning for disaster prevention. As with Japan's Urban River Inundation Damage Countermeasure Act and the United Kingdom's strategic flood risk assessments, they have been identifying disaster-vulnerable regions to formulate measures incorporating both disaster prevention facilities and urban planning elements and providing legal and institutional support for cooperation among the relevant government agencies. As in the Dutch example, the efficiency of disaster-prevention urban planning institutions has been bolstered through spatial adaptation measures that reflect characteristics at different regional spatial scales. While Korea is currently conducting disaster vulnerability assessment and formulating urban planning for disaster prevention that combine disaster prevention facilities with urban planning measures, linkages and implementation apply only in institutional terms, and the approach has been limited in its effectiveness. Specific constraints include a shortage of spatial data that can be used for both disaster prevention facilities and urban planning measures, while a lack of cooperation among the relevant agencies poses limitations in terms of executing urban planning policies for disaster prevention tailored to specific regional characteristics. Amending this situation will require the development of spatial data that can be commonly used; the establishment of a cooperative body to identify possibilities for practical cooperation beyond legal and institutional support; and the formulation of guidelines for providing customized measures and support reflecting regional characteristics.

3.2 Avenues for Improvement: Urban Regeneration Projects Incorporating Disaster Prevention Elements

Urban regeneration projects are a representative example of measures to bolster damage abatement capacities for previously developed regions that are in decline and exposed to disaster risks. Due to climate and topography factors, Korea is vulnerable to flooding and suffers many related damages. In the case of regions already developed as urban areas, the focus solely on development without regard for disaster prevention has resulted in many instances of flooding vulnerability. Because of their high development densities, however, previously developed regions pose many problems for the application of urban planning measures and structural measures employing disaster prevention facilities. In that sense, urban regeneration efforts for the redevelopment of regions in decline may be seen as a highly useful approach for addressing disaster vulnerability and reducing disaster risk in previously built urban areas. In that regard, the guidelines for urban regeneration strategic plan formulation recommend basic investigations to examine disaster risk and the designation of highly disaster-vulnerable regions as urban regeneration and revitalization zones, yet there have been almost no cases to date of urban regeneration and revitalization zones being designated on the basis of high disaster risk. A new "special regeneration region" system has recently been implemented in the wake of the Pohang earthquake, and the execution of urban regeneration projects that address disaster issues in regions that have experienced disasters may be seen as a very encouraging sign in the case of disasters such as earthquakes for which preparations in Korea have been inadequate. At the same time, consideration must also be extended to disasters such as flooding, which is currently responsible for the largest damages in Korea, and measures linked to urban regeneration efforts should be established not only for regions where disasters have already occurred, but also those that are vulnerable to future disasters. Urban regeneration projects are crucially important as a means of determining regional disaster vulnerability in advance and reducing vulnerability in previously developed urban areas.

Other countries have been reducing regional disaster vulnerability through urban regeneration projects. In Japan, the Urban Regeneration Special Law was amended to mandate formulation of plans to ensure safety in the execution of urban regeneration plans. In the Netherlands, a "slow city" strategy and other measures have been adopted for urban regeneration efforts that reduce damages through gradual approaches involving communication with residents rather than full-scale urban redevelopment, and environmentally friendly approaches such as Low Impact Development have been joined with measures like "water squares" involving urban infrastructure that can be used for different purposes in addition to disaster prevention. In Germany, consideration has recently been extended to the use of various environmentally friendly urban planning measures not only to adapt to climate change-related disasters but to mitigate their effects.

Improving urban regeneration policies to reflect disaster prevention first requires the analysis of regional disaster vulnerability, followed by measures to mandate the incorporation of disaster prevention elements in urban regeneration projects for vulnerable regions. One of the reasons for the inadequacy of existing measures in connection with this stems from recommendations that suggest investigating disaster-related areas only as a basic examination, allowing urban regeneration and revitalization region designations for regions facing a high disaster risk. With disaster prevention-oriented urban regeneration efforts recently emerging as an issue in the wake of the Pohang earthquake, Korea's urban regeneration policies should be developed to extend beyond efforts for regions previously damaged by earthquakes and introduce customized local urban regeneration projects that reflect different degrees of disaster vulnerability in consideration of the potential for other disasters and related damages.

CHAPTER IV.

Current Damage Recovery Capacity Policies and Avenues for Improvement

1. Transportation Planning for Disaster Prevention

The effects of urbanization have increased the likelihood of secondary damages being exacerbated as a result of traffic congestion in the event of a large-scale disaster. The ability to ensure swift mobility for emergency transportation, rescue efforts, and other parts of the disaster response is seen as a crucial element. In Korea, however, policies related to the formulation and implementation of disaster prevention-oriented transportation planning before disasters occur remain inadequate.

In recent cases of large-scale disasters in Korea, disaster response and recovery efforts have sometimes failed to take place promptly due to factors such as traffic congestion. When large disasters occur, surrounding areas are very likely to suffer extreme congestion due to evacuees and incoming response resources, resulting in enormous secondary damages as the disaster response and recovery are delayed.

At present, disaster responses and swift recovery efforts in Korea are focused chiefly on training and securing of necessary human and material resources; the relative failure to assign a role to roads for the swift transportation of resources remains an area in need of improvement (Lee, 2016). Article 43 of the Framework Act on the Management of Disasters and Safety prohibits traffic by vehicles other than those engaged in services such as emergency transportation, but no system exists to designate emergency transport routes beforehand to reflect factors such as disaster vulnerability. To address this issue, the Ministry of the Interior and Safety (MOIS, formerly the Ministry of Public Safety and Security), which is the chief agency responsible for disaster-related areas, has been working since 2015 to create the position of transportation cooperation officer within its Special Disaster Office, develop policies to address transportation and access issues in cases of disaster, and formulate plans for the designation of “emergency

transportation routes." As policy measures to support emergency routes and other disaster supply functions have yet to be established, MOIS conducted a related policy study in 2016,[06] while ordering the future investigation of related policies overseas to identify implications and suggest avenues for development.

To respond swiftly to disasters as they increase in diversity and complexity, MOIS has been working step-by-step on emergency transportation route plans with the aim of supplying the appropriate disaster resources (staff, goods, equipment, etc.) in a timely manner in the event of natural disasters (such as flooding or earthquakes) and man-made disasters (such as gas leaks). The target for the emergency routes is to be able to channel at least 80% of disaster response resources to the local government for the afflicted region from around the country within a period of 30 minutes to four hours. Emergency routes are to be assigned at three levels, the first of which designates connections between metropolitan local governments: chosen from among expressways and ordinary national highways, they represent the highest level of roadway between the sites storing major state disaster response goods and the locations of metropolitan local governments, and candidates must include bypasses and alternative routes. The second level consists of roads connecting the locations of metropolitan and basic local governments, which are to be chosen from among ordinary national highways and city/country roads to allow for the immediate movement of resources in the event of a disaster. The third level consists of roads connecting the locations of basic local governments to ensure a support system between said governments.

At the time of emergency transportation route designation, consideration is to be extended to the effects that the disaster has on roads and the role of special fire services, among other factors. Based on an examination of the 37 legally recognized forms of disasters, they have been assigned into three categories according to their effects on roads. Category I consists of disasters that do not affect roads (e.g., gas leaks, heat waves, and droughts). Category II consists of disasters associated with vibrations that affect infrastructure (e.g., earthquakes), while Category III includes disasters that result in roads becoming temporarily unusable according to terrain factors (e.g., typhoons and floods). Rather than assigning single routes, the emergency transportation route plan adopts an approach of pre-selecting and managing multiple routes that contain no overlap between the three categories. Another rule for emergency route designation is that consideration must be extended to the transportation of special equipment belonging to the seven special fire brigades nationwide (Central, Ulsan, Siheung, Seosan, Iksan, Yeosu, and Gumi), with plans to be developed to allow access for at least 75% of national special fire service resources within a period of three hours.

06. Ministry of the Interior and Safety, 2016. "Study on Disaster Route Designation and Usage."

Table 3. Emergency Transport Route Overview

Category		Details			
Purpose		To allow for unimpeded emergency vehicle access and control traffic by ordinary vehicles in the event of a disaster			
Method		Select highly disaster-resistant routes from among those linking disaster prevention bases			
Strategy		Designate and manage emergency routes at the time of national safety management framework plan development			Decision on designation powers to be made according to guidelines in the event of disaster
Stage		Preparation (before)			Response (after)
		Nearby local government support		Support within local government	Practical support at disaster site
Between	Starting Point	Metropolitan disaster prevention base	Metropolitan disaster prevention base	Basic disaster prevention base	Basic disaster prevention base
	End Point	Metropolitan disaster prevention base	Basic disaster prevention base	Basic disaster prevention base	Disaster scene
Guidance and Traffic Controls		Information provides through notices (signs)/homepage			Route information provided through VMS and navigation; police controls
Designation Powers		MOIS	Metropolitan local government	Basic local government	Official supervising disaster response on ground
Candidate Roads		Level I: Major highways and ordinary national highways	Level II: Major trunk roads and local roads	Level III: Major local roads	All available roads
Disaster Types		Four main disaster categories	Four main disaster categories		
Laws Examined		Framework Act on the Management of Disasters and Safety, Road Traffic Act, Construction Act, Land Use Regulations at the National Territory Plan and Use Act et al.			
Disaster Response Bases		Central govt. → Metropolitan local govt.	Metropolitan local govt. ↔ Metropolitan local govt.	Basic local govt. ↔ Basic local govt.	Disaster scene
		National disaster response base	Metropolitan disaster response base	Basic disaster response base	Disaster scene
Designating Institution		MOIS	Metropolitan govt.	Basic local govt.	Commanding official at disaster scene
Command Headquarters		Central Disaster Safety Countermeasures Headquarters, Central Emergency Rescue Control Team	City/Provincial Disaster Safety Countermeasures Headquarters; Emergency Rescue Control Team, City/Provincial Headquarters	City/County/District Disaster Safety Countermeasures Headquarters, Fire Station Emergency Rescue Control Team	Disaster scene command post, highest-ranking commander
Roads Affects		Expressways, national highways	National highways, city/provincial roads	City/provincial roads	Emergency routes near scene of disaster
Designation Time		Before	Before	Before	After
Maximum Usage Time[07]		4 hours	2 hours	2 hours	Emergency response period
Usage Strategy		Dedicated lanes /Restrictions on entering and exiting traffic/One-way traffic	Dedicated lanes/Full-scale restrictions /One-way traffic	Dedicated lanes /Full-scale restrictions/One-way traffic	Dedicated lanes /Full-scale restrictions/One-way traffic

Source: Ministry of the Interior and Safety, 2016. *Study on Disaster Route Designation and Usage*, p. 106.

07. A maximum time is set for the longest transport disaster distance for response goods between individual starting and end points, with a maximum usage time representing the largest travel time within the region. In the case of emergency supplies, later-arriving disaster response resources are more important than primary ones in emergency. Accordingly, the time may be increased after a careful consideration of the road environment to ensure that the maximum resources can be supplied to the disaster scene or its vicinity.

2. Pre-disaster Recovery Plan

According to Korea's Framework Act on the Management of Disasters and Safety and the Countermeasures against Natural Disasters Act, recovery plans are to be developed for specific disaster scenarios, with plans to be created after a survey of damages resulting from natural disasters. Article 59-1 of the Framework Act states that the head of the organization responsible for disaster management must develop and implement an independent recovery plan without delay upon completion of the damage survey; when a central disaster damage joint investigation team is formed, the plan is to be formulated and executed after notification of the disaster damage recovery plan from the central countermeasures headquarters director. Article 46 of the Countermeasures against Natural Disasters Act states that an independent recovery plan must be developed and implemented immediately upon the occurrence of a disaster.

Table 4. Major Recovery-related Content in Disaster Prevention Laws and Institutions

Disaster Prevention-related Law	Framework Act on the Management of Disasters and Safety		Countermeasures against Natural Disasters Act
Recovery	Damage survey and recover plan	· Reporting and investigating disaster-related damages · Developing and implementing disaster recovery plan · Managing disaster recovery efforts · Managing projects according to disaster recovery plan	· Developing and implementing disaster recovery plans · Leader of disaster team · Formulating general regional-level recovery plan · Central joint investigation team · Training officials to perform disaster surveys · Drafting and announcing disaster recovery effort implementation plan · Executing large-scale disaster recovery efforts and general regional-level recovery efforts · Methods of contract selection for recovery-related construction · Pre-payment of recovery costs · Settlement of recovery budget · Priority supplies of recovery materials et al. · Repayment of recovery costs et al. · Managing recovery efforts · Annual reports on natural disaster recovery · Acquisition of land et al. · Analysis and assessment of recovery projects
	Special disaster area declaration and support	· Declaring special disaster areas · Supporting special disaster areas	
	Funding and compensation	· Principles of cost distribution · Costs for emergency assistance · Compensation for loss · Medical treatment and compensation · Rewards · State assistance for disaster areas and other support	

Source: Adapted from content of the Framework Act on the Management of Disasters and Safety and the Countermeasures against Natural Disaster Act.

Recovery-related content is included in safety management framework plans based in the Framework Act on the Management of Disasters and Safety. These plans are to be formulated every five years and include detailed content for each stage of the disaster response process, including prevention, preparation, response, and recovery. Local government recovery plan development is to be based on the "Guidelines for Natural Disaster Survey and Recovery Plan Formulation."

In 2014, Seoul developed a safety management framework plan following a general survey of damages and recovery conditions in the wake of the 2011 Umyeonsan Mountain landslide. The recovery plan consisted largely of recovery policies, a priority recovery cost support system for areas related to public welfare, surveys on flood-related damages, recovery plan formulation, and assignment of recovery planning duties. These recovery measures, however, were restricted to the region where damages occurred, with a focus on structural measures and instructions to achieve a return to status quo levels. Moreover, disaster recovery conditions are restricted to structure measures including the covering of affected areas with plastic and the installation of screens to present soil leakage.

In the US, where large-scale natural disasters happen frequently, not only the central government but also state governments operate systems for pre-recovery planning. The Post-disaster Redevelopment Planning (PDRP) guidelines established in 2011 for the state of Florida are intended chiefly to strengthen regional resilience through the pre-formulation of a mitigation-oriented recovery plan before disaster occurs, and through the "reshaping" of regions rather than a simple return to the status quo.

The Florida PDRP is a general plan that effectively marks the intersection among a comprehensive regional plan (along the lines of Korea's urban plans), a safety management framework plan, and a comprehensive plan for storm and flood damage reduction. It serves as guidelines to improve regional resilience through the development of an advance plan for redevelopment.

The PDRP guidelines call for "minimum," "recommended," and "advanced" planning levels for six disaster recovery-related areas (land use, housing, economic redevelopment, infrastructure and public facilities, health and social services, and the environment).

Table 5. Florida PDRP Target Levels by Topic

Source: Adapted from Florida Department of Community Affairs et al. 2010. *Post-disaster Redevelopment Planning*, pp. 42–43.

Topic	Target Level	Plan Content
Land Use	Minimum	· Phased reconstruction and streamlined permitting · Reformulating standards for illegal structures and structures suffering large-scale damages
	Recommended	· Long-term post-disaster damage management · Reducing disaster vulnerability through voluntary mitigation programs
	Advanced	· Prioritizing areas to focus redevelopment · Preserving and restoring historic sites · Mitigating disaster vulnerably through land use and development regulations
Housing	Minimum	· Temporary housing siting criteria, provision and removal · Capacity to swiftly rebuild housing
	Recommended	· Transitioning residents back to permanent housing
	Advanced	· Rebuilding affordable housing · Encouraging application of mitigation measures when homeowners redevelop
Economic Redevelopment	Minimum	· Resumption and retention of major employers · Assistance for small businesses
	Recommended	· Workforce retention · Tourism regeneration
	Advanced	· Physical and economic recovery projects · Opportunities to sustainably restore economic vitality
Infrastructure and Public Facilities	Minimum	· Infrastructure for temporary recovery operations · Debris removal · Financing infrastructure and public facilities repair
	Recommended	· Considerations for mitigation and historic sites
	Advanced	· Relocation of vulnerable infrastructure and public facilities · Considerations regarding regional infrastructure · Boosting infrastructure capacities within priority recovery areas
Health and Social Services	Minimum	· Health facility restoration · Social services to socioeconomically vulnerable populations · Restoring level of public security services for local government as a whole · Coordination and assistance for NGOs and volunteers · Assisting disabled residents through long-term recovery · Restoring and improving public transportation
	Recommended	· Schools, higher education reopened · Assistance for psychological and behavioral health · Retention and hiring of healthcare personnel
	Advanced	· Healthcare-related contamination and environmental justice · Quality of life elements
Environment	Minimum	· Beach and dune restoration · Environmental contamination · Environmental and historic review of temporary sites
	Recommended	· Restoring natural land and habitats · Green rebuilding · Park and urban forest restoration

The Pre-disaster Recovery Plan (PDRP) guidelines developed by FEMA in 2016 and 2017 were based on the Post-disaster Redevelopment Planning approach established in Florida in 2011 and others. While they differ in terms of their full name, they share the same goal in terms of developing detailed recovery plans prior to the occurrence of disasters and simultaneously implementing recovery and disaster prevention efforts.

FEMA's Pre-disaster Recovery Plan guidelines assign roles for state and federal government and stage-by-stage timelines for major activities and plan formulation. State government PDRP guidelines chiefly include content concerning selection of project priorities at the metropolitan level, budget usage, and linkages with local governments; when a disaster has not occurred, they call for the usage of the budget prepared for disaster recovery toward disaster reduction measures according to prevention project priorities. Local government PDRP guidelines indicate the roles of local governments, including the formulation of plans reflecting regional disaster characteristics, development of urban regeneration considering disaster prevention, methodologies for practical implementation plans (including local community involvement), and linkages with state and federal government plans. They also prescribe major activities at each stage of PDRP formulation and timelines for each planning stage.

3. Damage Recovery Capacity Reinforcement Policies: Avenues for Improvement

With recent rapid environmental changes resulting in an increased risk of disasters, the concept of resilience predicated on the possibility of disasters occurring is being introduced in the field of disaster prevention. Despite emphasis on the need for a swift response after disaster occurred and recovery efforts that incorporate preventive elements, related policies in Korea remain lacking. Policies related to the designation and operation of emergency transport routes have recently been discussed by MOIS and others as a form of transportation planning that meets disaster prevention needs, but progress remains at the policy research level. In Japan, where disasters occur frequently, various emergency transport routes have been systematically designated and operated according to their goals. Emergency routes in particular are responsible for aiding a swift response and recovery process in cases of disaster, as they involve a hierarchical linkage of different disaster response bases to reflect regional disaster vulnerabilities rather than simple linkages between local governments. Moreover, these routes have been institutionalized through the Disaster Countermeasures Basic Act and other legislation, allowing for close cooperation with presiding agencies. The US also has emergency transport route policies to enable a swift disaster response, providing a solid legal and institutional footing for linkages and cooperation between local governments for disaster-afflicted regions, neighboring local governments, and the central government.

In Korea, there have been cases of damages resulting from a failure to implement a disaster response and recovery processes in a timely manner following the occurrence of a disaster. Because of the potential for these damages to increase—particularly in large cities—the adoption of emergency route designation and management, as well as other forms of transportation planning that incorporate disaster prevention elements, is crucially important. Effectively implementing these policies will require the analysis of regional disaster vulnerabilities prior to the occurrence of disasters, with the findings to be reflected in the designation of disaster response roads, together with legal and institutional assistance to support robust cooperation among related agencies.

Because recovery capacity is premised on the occurrence of disasters, disaster recovery is extremely important, and the additional consideration of prevention for potential future disasters is crucially important for disaster recovery. While disaster recovery plans do exist in Korea, the chief approach generally adopts the standard of restoring the status quo through structural measures once a disaster has already occurred. In disaster recovery, it is of paramount importance not simply to restore and rebuild to recover the status quo, but to "reshape" as a way of preparing for potential future disasters. From that perspective, efforts have recently been under way in the US to develop guidelines for PDRP and encourage local governments to develop measures that reflect regional characteristics. In the Jersey Shore region of the northeastern US, which suffered severe damages due to Hurricane Sandy in 2012, locally tailored policies have been developed and implemented to increase regional resilience through restoration efforts.

Korea and the US differ substantially in the scale of natural disasters that they experience, and the wholesale adoption of the US PDRP system would have limited effectiveness in Korea. Flood-related damages in Korea have averaged in the area of KRW 500 billion per year over the past ten years; in the US, damages from single storms such as Hurricane Katrina or Sandy have exceeded the equivalent of KRW 100 trillion. Having experience with these enormous flood damages, the US has been able to adopt systems for the formulation of PDRPs. In Korea, however, calls for PDRP formulation may generally be met with some degree of incomprehension. With disasters involving damage to the Korea Power Exchange in Cheonan and earthquake damages in Pohang showing the possibility of Natech disasters occurring, some may recognize the need to consider the prevention of future disasters during the disaster recovery process. The complex interconnectedness of the modern city also means that damages to one region can have a negative long-term influence other regions and areas. It is therefore essential to introduce policies related to pre-disaster recovery planning, extending consideration to disaster prevention rather than simply restoring the status quo during the disaster recovery process.

CHAPTER V.

Major Policy Proposals for Achieving Resilient Cities

The previous section divided resilience capacity into damage abatement and recovery capacity, suggesting avenues for improvement to achieve resilient cities based on major issues with leading policies (respectively including urban planning for disaster prevention and urban regeneration considering disaster prevention for the first, and transportation plan considering disaster prevention and pre-disaster recovery plan for the second) and the implications of overseas examples (Table 6).

For all policies, the establishment of spatial data on flooding vulnerability has been suggested as an area for improvement. Establishing spatial data on flooding vulnerability means acquiring data that can not only be used for the building and management of existing disaster prevention facilities, but applied across all areas of urban planning, urban regeneration, transportation, and recovery planning. A pan-governmental system of cooperation also needed to be established to bolster cooperation and coordination of duties across departments to enable disaster prevention efforts executed chiefly by disaster prevention-related offices to be performed jointly with other departments, including those responsible for urban planning. Korea's current urban disaster prevention policies do include some measures aimed at reinforcing damage abatement capacity, but lack related measures to improve damage recovery capacity, including disaster transportation plan considering disaster prevention and PDRPs. Improving resilience will require the adoption of policies to improve damage recovery capacity as well. Efforts to improve regional disaster prevention capabilities will need to be combined with structural measures to improve resilience. Because regional disaster prevention capabilities are relatively vulnerable to change in terms of organization, budget, and community involvement factors, it is important that assessment and monitoring take place on a regular basis, with customized measures developed to reflect assessment outcomes.

Based on the aforementioned avenues for policy improvement, four general policy approaches are proposed: establishing all-purpose flood risk data, establishing a pan-governmental consultation system, adopting policies to improve damage recovery capacity, and institutionalizing resilience assessments and developing guidelines for resilience reinforcement.

Table 6. Korea's Major Resilience Reinforcement Policies and Implications from Overseas Cases

Resilience Reinforcement Strategy	Current Status in Korea	Limitations	Implications from Overseas Cases	Avenues for Improvement
Urban planning for disaster prevention	Institutional support	· Inadequate urban planning measures due to lack of concordance in spatial data · Insufficient cooperation among relevant agencies	· Apply disaster prevention facilities and urban planning measures after disaster vulnerability assessment · Strengthen inter-agency cooperation through legal/institutional support · Increase urban planning-related measures in addition to infrastructure-oriented ones	· Establish spatial data on flood vulnerability · Increase inter-agency cooperation
Urban regeneration considering disaster prevention efforts	Institutional support	· Inadequate implementation · Insufficient spatial data and application standards	· Actively incorporate disaster prevention planning when formulating urban regeneration plans · Apply low-impact development other eco-friendly means of implementation	· Establish criteria for urban regeneration implementation and application (establish spatial data on flood vulnerability and specify means of application)
Transportation plan considering disaster prevention	Policy research	· Lack of related institutions · Failure to reflect regional disaster vulnerabilities · Lack of cooperation system and related laws/institutions	· Designate and manage emergency transport routes reflecting regional disaster vulnerabilities · Ensure cooperation between local governments and different agencies with legal and institutional support	· Introduce related systems · Analyze flood vulnerability · Increase inter-agency cooperation
Pre-disaster recovery plan	Recovery plans exist, but no PDRP system	· Recovery plans developed after disasters occur · Basic aim of restoring status quo · Focused on structural measures · Lack of linkage between recovery and prevention stages	· Use disaster-related damages as an opportunity to develop PDRPs · Incorporate both disaster prevention facilities and urban planning-related measures, with planning at metropolitan level as needed · Develop differentiated measures reflecting regional characteristics · Encourage local government and community involvement	· Introduce related systems · Analyze vulnerabilities and regional characteristics · Encourage local government involvement and develop locally tailored measures

1. Developing All-purpose Flood Risk Data

Types of disaster maps are currently specified in Article 18 of the Enforcement Decree for Korea's Countermeasures against Natural Disasters Act. The disaster map types stipulated by the law consist broadly of maps of evidence of inundation, anticipated inundation, and disaster information. Inundation evidence maps provide indications of past damages, with evidence of inundation due to typhoons, heavy rainfalls , tidal waves, and other sources investigated and recorded. Anticipated inundation maps record predictions of rainfall and the scope of inundation due to typhoons, heavy rainfalls , tidal waves, and other sources based on current topography; they consist broadly of floodwater inundation risk maps and coastal inundation prediction maps. Floodwater inundation risk maps include both maps predicting and recording areas of inundation due to flood waters and faulty inner basin draining, as well as flood risk maps according Articles 7-1 and 7-5 of the Water Resource Investigation, Planning, and Management Act. Coastal inundation prediction maps predict and record coastal areas of inundation due to typhoons, heavy rainfalls , tidal waves, and other causes; for these maps, floodgate simulations are used to predict future flooding. For disaster

information maps, inundation evidence maps and anticipated inundation maps are used as a basis to recover information about evacuation guidelines, sites, and routes in the event of disaster. These are divided into evacuation, disaster prevention information, and disaster prevention education types. Evacuation information maps present diagrams of information about evacuation in the event of a disaster (including guidelines, centers, and routes); disaster prevention information maps are intended for daily use and contain inundation predictions, inundation facts, medical facility locations, and other disaster prevention-related information; and disaster prevention education maps are maps developed for educational use with content including guidelines for resident actions for different disaster types.

In addition to those specified in the Countermeasures against Natural Disasters Act, disaster risk maps are also developed in accordance with other laws. A storm and flood damage insurance management map is currently being developed in accordance with the storm and flood damage insurance management map drafting guidelines in Article 25 of the Storm and Flood Insurance Act. Storm and flood insurance currently operates on the same rate basis by city, county, and district. Since 2013, storm and flood damage insurance management maps have been under development for damages related to flooding, wind, and snow so that fees can be applied differentially even within the same administrative divisions according to their relative risk. Disaster vulnerability assessments are also being carried out in accordance with Article 28 of the Land Use regulations at the National Territory Plan and Use Act for uses as basic data when formulating urban planning for disaster prevention.

The currently developed disaster risk maps are limited in their applicability to formulating urban planning for disaster prevention that combines measures involving both disaster prevention facilities and urban planning elements. To begin with, the inundation evidence maps developed in accordance with the Countermeasures against Natural Disasters Act are based on past damages. While they provide the most reliable data, they do not take into account the effects of climate change and urbanization. Anticipated inundation maps use modeling to predict future outcomes, but they are generally intended to support the building of disaster prevention facilities and are limited in applicability to establishing urban planning measures. Disaster information maps are used to provide information for evacuation and education based on inundation evidence and anticipated inundation maps, which means they present the same limitations as those maps. The storm and flood damage insurance management maps that are currently being developed are intended as data to differentiate insurance costs for different risk zones; while they may be more applicable than the inundation evidence or anticipated inundation maps in a broad sense, they are also limited in terms of reflecting regional vulnerabilities and developing urban planning measures accordingly. Also, while disaster vulnerability assessments have involved the use of spatial indicator data to establish urban planning measures for disaster prevention, the lack of information about areas affected by inundation, among other things, poses limitations in terms of developing disaster prevention-oriented plans that take both structural and urban planning measures into account.

Table 7. Chief Characteristics of Disaster Risk Maps and Analyses

		Disaster Vulnerability Assessment	Storm and Flood Damage Insurance Maps	Anticipated Inundation Maps (Flood Risk, Coastal Inundation)	Inundation Evidence Maps	Disaster Information Maps
Scale of spatial analysis (nationwide)		△[08]	○	×	×	×
Analysis focus	Past	○	○	×	○	○
	Future	○	×	○	×	○
Analysis method	Floodgate analysis	×	○	○	×	○
	Spatial indicator data	○	×	×	×	×
Reflects regional flood vulnerability?		○	×	×	×	×

08. While methods for nationwide analysis have been suggested, no disaster vulnerability assessment maps have yet been developed at the national level.

The scope of flood risk data for use in both structural and urban planning measures must include not only floodwater inundation information for the building of disaster prevention facilities but also information about flood risks in regions outside of inundation areas for the development of various urban planning-related measures. This flood risk data must also include information about various components to the city, such as its infrastructure, buildings, and people. In addition to past climate change information, it also needs to include future climate change predictions to reflect future vulnerabilities to environmental change. Because the methods of disaster vulnerability assessment involve formulating urban planning for disaster prevention, the approach to such analyses should be improved to allow their use not only in the construction of disaster prevention facilities but also the formulation of urban planning measures.

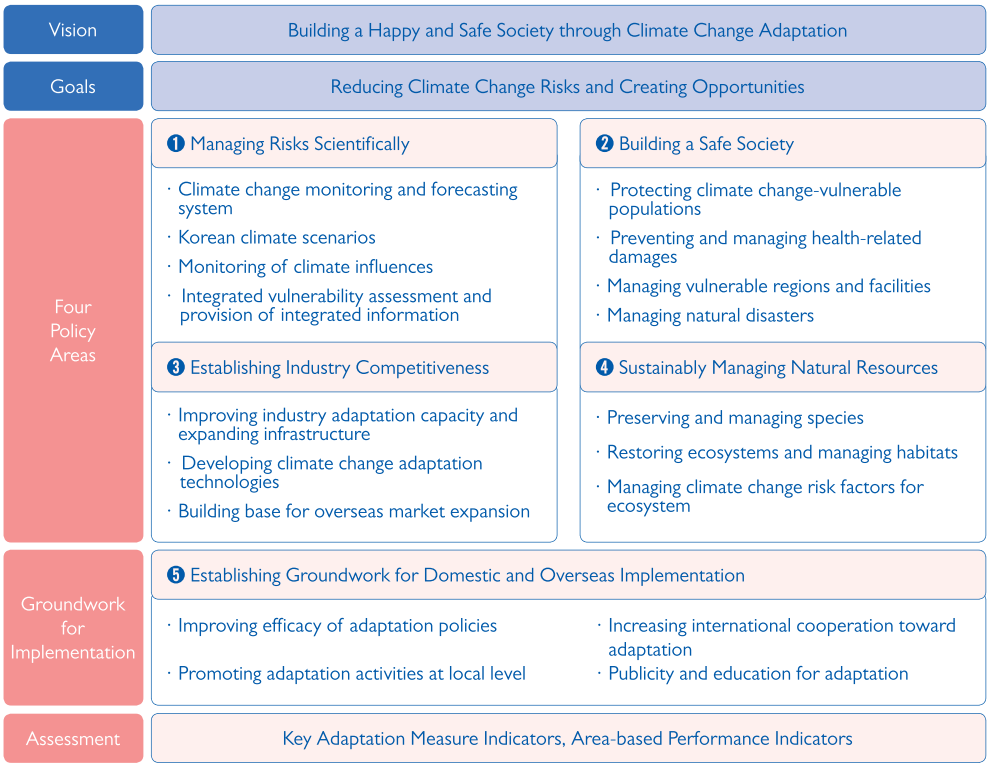
2. Establishing a Pan-governmental Consultation System

The recent emergence of a "Super-connectivity " society has resulted in limitations in terms of all relevant duties being executed by the same department or agency. In areas such as climate change and disaster prevention, which have broad-ranging influences, pan-governmental execution of related duties is becoming a necessity rather than an option. In reflection of this situation, Korea has developed and is currently implementing a National Climate Change Adaptation Plan involving pan-government cooperation to respond to climate change. The First National Climate Change Adaptation Plan was formulated in 2010 and executed jointly by 14 government ministries and agencies between 2011 and 2015. Outcomes of the first National Climate Change Adaptation Plan included the establishment of climate prediction figures, the development of plans for increased management based on analysis of vulnerabilities (e.g., farming and fishing, ecosystems, and infrastructure), and the formulation of measures for different local governments (17 state government, 168 local government). The Second National Climate Change Adaptation Plan (2016–2020) has involved the participation of a greater number of ministries and agencies than the first (20) and is focused on expanding and developing the outcomes of the first measures through stronger area linkages and integration based on scientific analysis of climate change risk. Internationally, they emphasize the importance of adapting to climate change; domestically, they focus on reflecting changing internal and external conditions, including heightened risk due to an accelerated population aging trend.

Based on a vision of achieving "a happy and safe society through climate change adaptation," the Second National Climate Change Adaptation Plan includes four policies to meet the aims of "reducing climate change risks and creating opportunities"—namely managing risks scientifically, building a safe society, establishing industry competitiveness, and sustainably managing natural resources. Based on the avenues for policy improvement identified in this study, cooperation among departments (including those related to disaster prevention, urban planning, and transportation) is essential to promote the efficacy of urban planning for disaster prevention development and to devise and implement transportation planning that incorporates disaster prevention elements. The effectiveness of urban regeneration efforts and pre-disaster recovery plans can also be improved through cooperation by different departments, including those involved in urban planning and disaster prevention. In that sense, the establishment of a pan-government consultation system is of critical importance. At the same time, there are many practical difficulties related to the establishment of a separate such system. For that reason, the Second National Climate Change Adaptation Plan, which is concerned with developing a pan-governmental consultation system for areas such as climate change and disasters, proposes ideas for improving resilience and discussing cooperation of duties across different departments. The achievement of resilient cities, which is a focus of this study, is very closely related to some of the four policy areas, including the scientific management of risks and the building of a safe society. Linkages with adaptation policy will also need to be strengthened on an ongoing basis to achieve greater resilience in cities.

Figure 3. Second National Climate Change Adaptation Plan: Vision and Goals

Source: Interagency joint publication, 2015. "Summary of Second National Climate Change Adaptation Measures (2016–2020)," p. 2.



3. Introducing Policies to Improve Damage Recovery Capacity

Since the Umyeonsan Mountain landslide in 2011, Korea has introduced policies to bolster damage abatement capacity, transitioning for its previous disaster prevention facilities-reliant measures to ones involving urban planning for disaster prevention and urban regeneration considering disaster prevention. Current measures to improve damage abatement capacity are still in their early stages of establishment and face some limitations; the establishment of policies related to damage recovery capacity remains inadequate.

Resilience presupposes the possibility of disasters occurring and requires the development of areas in the field of transportation to allow for a swift response in the event of a disaster. In addition to current disaster prevention policies that rely on staffing and resources for a swift response, emergency transport routes must also be designated and operated to reflect regional vulnerabilities before disaster strikes. The current Framework Act on the Management of Disasters and Safety includes content on traffic controls to allow for emergency transportation in the event of a disaster, but no policies or institutions exist for the prior designation and operation of emergency transport routes. Related laws must therefore establish a clear definition of said routes and avenues for their designation and management.

In addition to a swift response, it is also crucially important to prepare for potential future disasters through a disaster recovery process that incorporates prevention aspects. The US and other countries recommend the development of Pre-Disaster Recovery Plans (PDRPs) to increase local resilience during recovery efforts based on the possibility of future disasters occurring. Because of differences in the disaster characteristics and scale of damages in the US and Korea, the wholesale adoption of PDRPs predicated on disasters occurring would appear to be of limited effectiveness. At the same time, the risk of natural disasters occurring has increased due to factors such as climate change, with a very high likelihood of them developing into Natech disasters as their effects extend to the complex interlinkages of today's urban systems. It is therefore important to develop recovery plans that are linked to disaster prevention.

A PDRP system has recently been established in the US, where large-scale disasters occur with some frequency. Korea also needs to adopt a similar system that incorporates both recovery and prevention aspects. Introducing such a system in Korea will similarly require incorporating both recovery and prevention elements, with a system tailored to the country's situation based on close examination of examples in the US, which has experienced major damages from large-scale natural disasters in the past. For this study, areas for consideration when introducing a suitable situation in Korea were identified based on an examination of the US PDRP system.

In terms of the main content of US PDRPs, priority status for recovery or prevention efforts to prepare for possible disasters is determined ahead of time according to disaster vulnerability characteristics; when disasters do not occur, prevention efforts are carried out according to their priority status. As a source of projecting funding, consideration should be given to the systematic administration and usage of the legally mandated Disaster Management Fund, which is currently being established with yearly contributions by metropolitan and local governments.

Articles 67 and 68 of the Framework Act on the Management of Disasters and Safety mandate the depositing of 15% or more of the minimum reserve total from the Disaster Management Fund; the remainder may be used for suitable purposes. Stipulated purposes for which Disaster Management Fund may be used include public sector disaster prevention activities for disaster and safety management; the establishment, maintenance, and reinforcement of natural disaster reduction facilities (disaster forecasting and warning facilities); emergency recovery and other exigent measures for disaster-damaged facilities (state- or local government-owned or managed); efforts to reinforce local government emergency rescue capacity; support for relocation to temporary housing for residents subject to evacuation or eviction orders and financing for housing rental costs; research and investigations to analyze the causes of disaster and reduce related damages; counseling for the psychological stability and social adaptation of disaster victims; and emergence response and recovery measures to prevent the spread of contagious diseases and livestock infections. While metropolitan and other local governments receive yearly Disaster Management Fund reserve payments, these are not actively used for prevention efforts. Consideration should also be given to the use of Disaster Management Fund payments toward recovery costs when disasters occur, and prevention project costs when they do not.

The role of state and local government must be clearly established when developing plans that simultaneously take recovery and prevention into account. When response measures are implemented after a disaster, and prevention and recovery efforts are carried out, the organization accorded priority status is the local government, which experiences the damages directly and is required to establish countermeasures. In a broader sense, however, state governments also perform a very important role in coordinating and managing roles between local governments. In 2016 and 2017, FEMA created and presented PDRP development guidelines for state and local governments, respectively. According to these US PDRP guidelines, the role of state governments is focused on general areas including coordination of roles between local governments, assisting and encouraging local governments, and monitoring, while the role of local governments is focused on practical matters such as establishing local prevention project priorities, encouraging community involvement, and building systems for cooperation with regional institutions. In that sense, a system for PDRPs and other measures tailored to Korea's characteristics should be introduced, with the roles of metropolitan and local governments clearly specified.

The US PDRP guidelines state that plans should be formulated either separately or within the context of urban planning, with linkages to urban, disaster prevention, and safety planning. While it is not the same as a PDRP, Korea's approach to urban planning for disaster prevention stipulates that disaster vulnerabilities should be analyzed first before developing urban planning measures, and the sharing of disaster risk area information such as comprehensive plans for storm and flood damage reduction is encouraged as a way of strengthening linkages with existing disaster prevention measures. At the same time, this is restricted to simple data sharing, with insufficient cooperation among agencies and a failure to adequately reflect the core purpose of urban planning policy for disaster prevention. Florida's Post-disaster Redevelopment Planning approach, which serves as the basis for Pre-Disaster Recovery Plans in the US, emphasizes the importance of linkages between urban, disaster prevention, and safety planning and recommends the development of separate Post-disaster Redevelopment Planning as needed. Japan, where the Urban River Inundation Damage Countermeasure Act was enacted to produce comprehensive structural and nonstructural measures for specific regions in response to the frequent occurrence of flood damages in city centers, has also stressed the importance of linking urban, disaster prevention, and safety planning and formulating separate disaster prevention measures.

In addition to the structural recovery efforts presented in traditional disaster prevention measures, Pre-disaster Recovery Plan and other plans that incorporate both prevention and post-disaster recovery elements also need to include content on land usage, housing, infrastructure and public facilities, the environment, and health and social services, as well as recovery and revitalization of the local economy from a long-term perspective. Floods and other natural disasters have been increasing in scale; flooding in particular has the potential to affect the local economy beyond the inundation and direct damage suffered in any given region. The damage suffered by the Hyundai Motor plant in Ulsan as a result of Typhoon Chaba in 2016 and the flooding that occurred at Cheonan's Korea Power Exchange in 2017 can be seen as showing the potential for disasters in one region to escalate into Natech disasters capable of impacting that region's economic conditions and those of other regions. Because of factors such as climate change and urbanization, such disasters may occur again at any time in the future, and consideration should therefore be given not only to development of disaster prevention facilities and urban planning measures, but also to areas such as the environment, health and social services, and recovery and revitalization of the local economy. Having experienced large-scale damages including the collapse of the New Orleans economy due to Hurricane Katrina in 2005 and the deterioration of the Atlantic City economy due to Hurricane Sandy in 2012, the US has proposed the formulation of Pre-disaster Recovery Plan as comprehensive plans that incorporate a broader range of areas beyond disaster prevention. The environment is another area of crucial importance in PDRP development. Rapid urban encroachment has resulted in the destruction of ecosystems that once performed a natural disaster prevention role, and traditionally vulnerable regions have been developed for purposes of convenience and scenery. In the case of New Orleans in 2005, the collapse of the ecosystem that performed a natural disaster prevention role was cited as a factor exacerbating damages. In reflection of this, the US PDRP approach includes six topics (land use, housing, infrastructure and public facilities, environment, health and social services, and economic redevelopment) and suggests minimum, recommended, and advanced targets to achieve in view of individual local

government characteristics. Related areas and minimum targets will also need to be reestablished in the future formulation of a PDRP system suited to Korea's situation.

Korea's Guidelines on City Climate Change-related Disaster Vulnerability Assessments and Their Use currently stipulate the use of disaster vulnerability analyses as basic data when developing urban planning for disaster prevention; in 2017, these guidelines were partially amended to suggest the "development of urban planning for disaster prevention reflecting city resilience." From this, it can be seen that the focus of urban planning for disaster prevention is not solely on disaster prevention, but is also concerned with recovery through its incorporation of the resilience concept. In that sense, avenues should be sought for the introduction of a related system through the consideration of PDRP-related details and their inclusion in the current urban planning for disaster prevention after being adjusted to suit the Korean situation.

4. Institutionalizing Resilience Assessments and Establishing Guidelines

In addition to nonstructural measures to develop regional disaster response capacity, the improvement of resilience also entails the strengthening of disaster prevention facilities design standards and the implementation of urban planning measures. The first-year study suggested means of assessing resilience primarily in terms of nonstructural measures, including organizations, budget, and public participation, while the second-year study suggested avenues for strengthening resilience in urban planning terms, which is currently a weakness in Korea.

The resilience assessment approach developed in the first-year study interpreted resilience to refer to local capabilities at all stages of disaster response, taking into account local climate and physical disaster vulnerabilities. Disaster vulnerability assessment findings at the national level were used to assess regional vulnerability, while the disaster-related capabilities component of resilience was assessed at the national and local government levels through detailed findings from disaster management condition reviews conducted by the Ministry of the Interior and Safety (MOIS). Every year, MOIS implements disaster management condition reviews and other systems to detect and monitor local government capabilities, with administrative and financial incentives offered to local governments based on the assessment results. This motivation of local governments through yearly assessments of variable capabilities and provision of incentives is extremely important. Strengthening local resilience, however, will require more than the simple offering of incentives based on assessment findings; resilience assessment results will need to be used to establish plans for reducing vulnerability in urban planning terms and encourage community involvement. This will first require linkages with current systems such as disaster vulnerability assessments and disaster management condition reviews, with resilience assessment methods to be institutionalized and assessment findings monitored on an ongoing basis.

Locally tailored guidelines for the strengthening of resilience will also need to be developed in connection with the resilience assessment findings. In the US, the Community Rating System (CRS) has been introduced to evaluate local resilience, with findings linked to storm and flood damage insurance and other areas to encourage local government and resident involvement in a locally tailored resilience reinforcement approach. The US Department of Housing and Urban Development (HUD) has also held various competitions on strengthening resilience and encouraged local government participation in boosting resilience in light of regional characteristics. In consideration of this, Korea also needs to institutionalize measures for resilience assessment and reinforcement and establish related guidelines to increase efficacy. Resilience guidelines should encompass resilience assessment methods, vulnerability identification, suggestions for improvement, and locally tailored measures. A system of urban planning for disaster prevention has currently been introduced and is developing to incorporate recovery in addition to prevention. To date, however, no clear guidelines have been presented for the development of urban planning for disaster prevention; instead, only fragmented content has been provided through disaster prevention zone guidelines, the directions indicated in the Guidelines on City Climate Change-related Disaster Vulnerability Assessment and Its Use, and KRIHS education efforts for local government officials. In consideration of this, guidelines should be developed for urban planning for disaster prevention, which should be expanded and developed into guidelines for strengthening resilience through the inclusion of resilience assessments and methods for their application, identification of vulnerabilities, and locally tailored measures.

CHAPTER VI.

Conclusion

The damages caused by natural disasters have intensified as a result of climate change and urbanization. Flooding damage due to typhoons and heavy rainfalls account for approximately 90% of all natural disaster damages occurring in Korea. Despite active disaster planning policy and research efforts in recent years, the trend is one of increased likelihood of large-scale disasters due to climate change, urbanization, and other environmental changes, and the concept of resilience, which presumes the likelihood of disasters occurring, has been increasingly incorporated into disaster prevention policies.

Under these circumstances, the current study suggested potential avenues for increasing resilience in the area of urban disaster prevention for the flooding that accounts for the largest share of damages in Korea. The study is broadly divided into first- and second-year components. The first-year study suggests methods for assessing resilience. The resilience assessment defined resilience as a region's capabilities across all stages of disaster response in light of local climate and physical disaster vulnerabilities, with a framework developed to assess resilience in terms of Management Targets (Vulnerable area, Urban infrastructure, vulnerable citizens, building) and Assessment Target (organization, budget, public participation) and used to assess resilience at the national level.

For the second-year study, research was performed on avenues for achieving resilient cities with a focus on improving resilience in urban planning terms, an area inadequately addressed in the first-year study. The elements constituting resilience were categorized into damage abatement and damage recovery capacities depending on whether they apply before or after disaster occurs. While policies to improve damage abatement capacit y are being implemented in Korea in the form of urban planning for disaster prevention and urban regeneration considering disaster prevention, policies to improve damage recovery capacity remain lacking. In connection with the area of damage recovery capacity, examinations were performed on disaster prevention-oriented transportation planning for disaster response and recovery and the Pre-disaster Recovery Plans recently introduced in the US as a leading policy effort to improve resilience. Current related policies in Korea were examined to identify problem areas, and the implications of overseas cases were used as a basis for suggesting avenues for improving Korean policies.

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KRIHS SPECIAL REPORT 40

RESEARCH ON REGIONAL RESILIENCE IMPROVEMENT COPING WITH FLOODING DISASTER BY CLIMATE CHANGE EFFECT (II)

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