

An Assessment of Flood Mitigation Policies Integrated in Local Comprehensive Plans: The Case of Florida in the United States

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지자체 도시기본계획의 홍수예방정책 평가: 미국 플로리다 사례를 중심으로

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국문 요약

계획가들은 지자체가 기후변화로 심화되고 있는 홍수에 대해 더욱 관심을 가지고 적절한 홍수예방정책을 도시계획에 통합하고 반영한다면 홍수피해를 줄이는데 기여할 수 있을 것이라고 믿고 있다. 이러한 계획가들의 생각을 검증하기 위한 첫 번째 단계로 지자체 도시기본계획에 채택된 홍수예방정책들의 종류와 수준을 계획평가 방법론을 활용하여 평가하였다. 주요 홍수예방정책들로 구성된 프로토콜을 바탕으로 플로리다 53개 지자체 도시기본계획이 분석되었다. 본 연구의 분석결과 도시별로 도시기본계획에서 채택한 수해예방정책의 종류와 수준이 상당히 다양함을 보였다. 플로리다에서는 홍수터의 토지이용 규제, 습지개발허가제 등 토지이용규제를 활용한 홍수예방정책들이 폭넓은 동의를 얻어 활용되고 있는데 반해, 취약지에 대한 토지수용, 인센티브를 활용한 홍수예방정책들은 자주 채택되고 있지 않았다. 또한 해안가 도시들이 내륙도시보다는 도시계획을 통한 홍수예방에 훨씬 더 높은 관심을 보였다. 연구대상인 53개 계획의 평가점수는 평균 38.55로, 획득가능한 점수의 약 35.69%에 해당하여 여전히 지자체 차원에서 다양한 홍수예방정책이 수립되고 활용되고 있지 않으며 이러한 결과는 앞으로 더 많은 관심과 개선이 필요함을 의미한다. 본 연구에서 활용된 계획평가의 개념과 방법론은 기존계획의 수준을 평가하거나, 새로운 정책이나 계획을 준비하는데 유용한 틀을 제공하므로 우리나라에서도 다양한 환경, 재해 이슈에 적용할 수 있다.

주제어 | 도시기본계획, 홍수예방정책, 계획의 질, 계획평가

Abstract

'Planning researchers' believe that losses from floods can be reduced if governments address this issue and adopt appropriate policies in their plan. As a starting point for examining this idea, this research assessed the ability of local government to incorporate flood mitigation policies in their local comprehensive plans using plan quality evaluation methodology. This study analyzed 53 local

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comprehensive plans in Florida against the protocol developed by including key flood mitigation policies. While flood mitigation through land use management tools, such as permitted land use in floodplain areas and wetland permit, gained widespread acceptance at the local level in Florida, incentive based tools/taxing tools and acquisition tools were rarely adopted. Study results show that 53 local plans in the sample received a mean score for total flood mitigation policy quality of 38.55, which represents 35.69 % of the total possible points. These findings indicate that there is still considerable room for improvement by local governments on flood issues. The scores of local plans varied widely, with coastal communities receiving significantly higher scores than non-coastal communities. Because the concept of the plan quality and its methodology offer an objective and straightforward tool for studying plan quality and guiding plan preparation, they can be applied to various environmental and hazard issues in Korea.

Keywords Local comprehensive plan, Flood mitigation policies, Plan quality, Plan evaluation

I. Introduction

Natural disasters can have an overwhelming short-term and long-term impact on the entire society and economy of an area. Of them, flooding is one of the most common and ubiquitous natural hazards and many communities suffer from repetitive flooding over time, both in the U.S. and worldwide. Flooding events caused by climate change have increased and are expected to exacerbate.

Until the 1960s, the United States focused on structural measures such as building levees, dams and flood walls for flood management. The structures actually provide a great degree of protection from repetitive floods (Birkland et al., 2003) and they are effective in highly dense places which have rare safe areas. However, these approaches were criticized because of adverse impacts such as destroying ecosystems and creating a false sense of security. In addition, structures which are designed to reduce the probability of loss only up to a certain degree can produce a catastrophic damage if disasters exceed such magnitude. In the late 1960s, as a result of several flood disasters, a new flood policy emerged as a form of the National Flood Insurance Program (NFIP). This program succeeded in more widespread public identification of flood hazards as well as reduced development by raising the cost of land preparation, construction and insurance (Interagency Floodplain Management Review

Committee, 1994). However, insurance can lead to greater exposure to flood risk. It is called “moral hazard” which is an increase in the probability of loss when policy holders behave more careless than before (Kunreuther and Roth, 1998).

Land use and relocation strategies away from hazardous areas have become emphasized since the 1980s even though the basic idea had a long history (White, 1936). Current land use is one element of a local comprehensive plan (general plan) which guides a community's desirable future land use and development pattern. In the United States, like Korea, local governments are mainly responsible for land use planning and regulation (Hoch et al., 2000). Thus, their role in flood mitigation is essential and critical (Godschalk et al., 1999; Brody et al., 2011). In fact, many localities in the US are adopting and implementing flood mitigation actions to minimize losses through local land use planning initiatives. However, in most jurisdictions, natural hazards have not had a high priority in governmental policies (Burby, 2005). With concerns about the increase of flood disasters, more research and continuous attention are needed to be addressed.

Many previous studies have focused on conceptualizing plan quality (Kaiser et al., 1995; Brody, 2003a; Brody, 2003b) and made more systematic evaluation methodology (Berke, 1994; Berke and French, 1994; Burby and Dalton, 1994; Berke et al. 2009; Berke and Godschalk, 2010). Using the plan evaluation framework, researchers have evaluated plan quality for natural hazards (Berke, 1994; Berke and French, 1994; Burby and Dalton, 1994), ecosystem management (Brody, 2003a), strategic environmental assessment (Tang, 2008), sustainability (Berke and Manta-Conroy, 2000) and climate change action (Tang et al., 2010). However, comparatively small amount of studies have directly focused on single hazard - floods. Studies focused only on flood hazards can reflect its own characteristics and can give a specific view for mitigating flood damage.

This study addresses the gap in the planning and hazard literature. The purpose of this study is to evaluate the extent to which local comprehensive plans integrate flood mitigation policies using plan quality evaluation routine. In particular, what actions local jurisdictions have taken to mitigate flood losses and which policies receive the greatest and least attention. Understanding the degree to which local communities incorporate flood mitigation polices can provide important insights into how flood can be strategically managed in the

future. The jurisdictions with various and critical flood mitigation policies indicate a serious consideration and commitment for flood mitigation.

This research is focused on Florida in the US which is at the forefront of flood mitigation policies. The results will provide valuable information not only to the US local communities but also to Korean local communities regarding a range of regulatory and policy mechanism which can be implemented on local level.

The following section defines key flood mitigation policies for developing a plan quality evaluation protocol. Sample selection of study area and data analysis procedures are then described. Next, analysis results are presented for components as well as each policy within a component. Finally, this study suggests policy implications and applications of the research methodology to Korea by conducting a pilot analysis.

II. Defining Key Flood Mitigation Policies for Plan Quality Evaluation

If plans aim to achieve their full potential, they should reflect the highest quality of thought and practice. Systemic evaluation allows us to identify their specific strengths and weakness and to judge the overall plan quality. A group of researchers (Berke, 1994; Berke and French, 1994; Burby and Dalton, 1994; Berke et al. 2009) have made effort to design and apply a systematic approach to evaluate plan quality. Researchers developed a framework which captures the characteristics of plan contents. Based on the framework, researchers developed their own protocol according to their purposes by incorporating principles and measures.

To enhance preparedness for repetitive floods, local comprehensive plans should indicate concrete policy actions. Policy is the heart of a plan because it actualizes the plan's objectives by being implemented in the real world (Kaiser et al., 1995; Berke et al., 2006).

Based on the literature review, this section has listed flood mitigation policies that are needed to be incorporated in local comprehensive plans in plan evaluation protocol. Namely, the developed evaluation protocol includes essential and effective flood mitigation policies.

Flood hazard mitigation can be divided broadly into structural and non-structural

approaches according to whether engineering or administrative methods are used (Thampapillai and Musgrave, 1985). Historically, in the United States, structural mitigation techniques have dominated flood management since the 1927 Mississippi River flood (Birkland et al., 2003). Structural approaches are based on the willingness of humans to control floods or protect human settlements (Alexander, 2000). They include the building of seawalls and revetments, levees, riprap, bulk heads, channels and properly designed storm water management system. Retention and detention are capable of providing sufficient storage to limit peak discharge rate. Structural approaches usually put a large amount of financial burden and can impose negative impacts on the natural environment (Brody et al., 2011).

Non-structural approaches are based on adjustment of human activities and human society to mitigate flood damage (Alexander, 2000). They include land use management, insurance, awareness, environmentally sensitive area protection and other emergency/recovery policies.

Land use management technique guides development away from vulnerable areas and this approach includes implementation of regulatory policies, tax and incentive based policies, acquisition policies and public facilities and infrastructure related policies (Godschalk et al, 1998). The regulatory tools can be categorized into land use and zoning tools, site design tools and building design regulations. These tools can regulate location, type, density, structures for preventing losses caused by floods. Tax and incentive based tools induce land use away from floodplains using special taxes, fees and density bonus. Acquisition policies are the most promising way to prevent development in flood prone areas by purchasing land or property. These tools also include transfer and purchase of development rights, dedication of conservation easement or open space, and relocation of vulnerable buildings or damaged buildings. Public facilities and infrastructures can be safe from flooding by regulating design and location by controlling public expenditure through capital improvement program and retrofitting structures.

Flood insurance which is provided by National Flood Insurance Program (NFIP), has had the most dominant non-structural flood mitigation policy in the United States. Conceptually, insurance allows the transfer of financial risk from an individual to a pooled group under contract. The federal government has been managing this program. Community participation

and individual participation were completely voluntary until 1974, when the rates of participation and purchase were very low. However, the Flood Disaster Protection Act in 1973 strengthened the NFIP and participation of communities in NFIP was a condition of eligibility for certain types of federal assistance (Holladay and Schwartz, 2010). In addition to flood insurance, FEMA has proposed a Community Rating System (CRS) to go beyond the minimum NFIP requirement. Communities that participate in this program can receive an additional discount based on their planning and management activities such as providing public information, mapping and regulation, flood damage reduction, and flood preparedness (Brody et al, 2011).

Awareness of risk is the first step for preparing and implementing a policy and includes various education tools both for the public and related personnel. Education and outreach programs through the community can enhance residents' awareness and preparedness of flood hazards using workshop, meeting, media, newsletter, and pamphlets. Also, awareness approach includes flood forecasting, warning and response program, flood maps and technical assistant and training for staff.

Environmentally sensitive areas include wetlands, barrier islands, estuaries, endangered species habitats, water supply reservoir buffers, dunes and forests. Protection of these areas is closely correlated to ensure that the flood-carrying and flood storage capacity are maintained. In addition, they are important to sustain natural ecosystems and mitigate hazard impacts by absorbing wind and wave impacts. Maintaining and enhancing these areas can be realized through acquiring property or development rights in floodplains, limiting development in the areas or restoring these areas.

Total of 54 flood mitigation policies were chosen to develop the evaluation protocol and they were categorized into twelve sub-components: general policy, land use and zoning tools, site design tools, building standard tools, acquisition tools, incentive based tool/taxing tools, insurance tools, structural tools, awareness/educational tools, public facilities and infrastructure tools, emergency/recovery preparedness tools, natural resource/sensitive area protection tools (Table 1). This protocol can not only serve as an evaluation protocol but also can be a guideline for plan preparation.

Generally, comprehensive plan is composed of elements of land use, housing,

infrastructure, coastal management, conservation, intergovernmental coordination, capital improvement and transportation (Brody et al. 2011). Flood hazards are mainly addressed in the coastal management element. However, other elements, such as future land use, transportation, and conservation must also address flood management issues. Thus, this research evaluated all elements of comprehensive plans to assess how well local governments employ flood mitigation policies through local comprehensive plans.

Table 1 Flood Mitigation Policy Evaluation Protocol

<p>General policy(2)</p> <ul style="list-style-type: none"> -Discourage development in floodplain area -Consistency with other regulation, laws or plans(i.e. flood ordinance) <p>Land use and zoning tool(6)</p> <ul style="list-style-type: none"> -Permitted land use -Wetland regulation using permit -Low density conservation -Overlay zone with reduced density provision -Down zoning of floodplains <p>Site design tool(6)</p> <ul style="list-style-type: none"> -Site plan review -Special study/impact assessment for development in floodplains -Setbacks/buffers -Cluster development to keep development away from floodzones -Subdivision regulation <p>Building standard tool(3)</p> <ul style="list-style-type: none"> -Building standards/building code -Strengthening structures to meet current codes or regulations(i.e. elevation) -Low interest loans to retrofit structures <p>Acquisition tool(5)</p> <ul style="list-style-type: none"> -Land and property acquisition(fee simple purchase) -Dedication of open space for hazards/Dedication of conservation easement -Transfer of development rights -Purchase of development rights -Relocation of vulnerable structures out of hazard zones 	<p>Insurance tool(2)</p> <ul style="list-style-type: none"> -Participation in flood insurance program(NFIP) -Participation to Community Rating System(CRS) <p>Structural tool(10)</p> <ul style="list-style-type: none"> -Detention ponds/retention/holding -Levees -Dams -Seawalls -Riprap -Bulkheads -Channel maintenance/Channelization -Slope stabilization -Storm water management -Cleaning of debris <p>Awareness/Educational tool(7)</p> <ul style="list-style-type: none"> -Education/outreach program -Real estate hazard disclosure -Flood forecasting, warning and response program -Training/technical assistance -Maps of areas subject to flood hazards -Computer models/evacuation systems(e.g., HEC, web-based modeling system) -Database <p>Public facilities and infrastructure(3)</p> <ul style="list-style-type: none"> -Capital improvements -Monitoring/retrofitting public structure -Policy not to locate public facilities in flood zones <p>Emergency/recovery preparedness(3)</p> <ul style="list-style-type: none"> -Evacuation/shelter preparedness -Emergency plan preparedness -Recovery plan preparedness
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<p>Incentive-based tool/taxing tool(3)</p> <ul style="list-style-type: none"> -Impact fees -Tax abatement for using mitigation -Density bonus 	<p>Natural resource/Sensitive area protection(6)</p> <ul style="list-style-type: none"> -General description of natural resource and sensitive area protection for flood mitigation -Wetlands conservation/restoration -Dune protection -Forest and vegetation management riparian areas -Sediment and erosion control regulation -Stream dumping regulations
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III. Methods

1. Study Area and Sample Selection

Study area of this research is Florida which is a peninsular state. Florida's population in 2010 is 18 million, making it the 4th largest state (US Census, 2010). As Florida contains vast wetlands and coastal areas, population and development have been concentrated in low-lying areas near the coast. Due to these characteristics, Florida is one of the highest risk states from flooding (FEMA, 1997), property damage caused by floods reached almost \$2.5 billion in the period of 1990 to 2003 and Florida is one of the highest risk states from flooding (FEMA, 1997). In terms of planning practice, there are wide variations among states in the United States. As of 2006, eleven states required local governments to have comprehensive plans with coastal hazard mitigation elements (American Planning Association, 2007). Florida is one of them and adopted a statewide mandate requiring all local jurisdictions to adopt a legally binding comprehensive plans and established minimum criteria for local comprehensive plans through Rule 9J-5 of Florida Administrative Code (Chapin et al., 2007).

Florida has quite similar geographic setting and planning background to Korea. Both are situated on peninsular and flooding is a repetitive and serious risk to them. Furthermore, they all require local comprehensive plans regarding hazard or safety element. However, Florida has been in the forefront of comprehensive planning and flood mitigation policies. Assessment of Florida local comprehensive plans will give implications to Korea concerning

what kind of mitigation policies can be integrated in local plans and effective for flood mitigation.

This study took a random sampling of local jurisdictions in Florida with the following strategy; 1) the sample was limited to jurisdictions within 100 miles of the Florida coastlines with a population of 5000 or more, in order to not let this study skew toward small communities; and 2) large cities were excluded in order to prevent a biased impact. Based on these criteria, 264 jurisdictions were sampled and an internet survey was sent to planners in those communities. Among 93 jurisdictions responded, jurisdictions which had no flood during the last five years were excluded. Overall, this study analyzed 53 local comprehensive plans.

2. Plan Evaluation Methodology

Plan quality was measured by scoring plans against the evaluation protocol. The coding scheme and procedure followed the existing methodology of plan quality evaluation studies (Berke and Beatley, 1992; Dalton and Burby, 1994; Burby and May, 1997; Olshansky and Kartez, 1998; Brody, 2003a,b; Berke et al., 2006; Tang, 2008; Kang et al., 2010; Tang et al., 2010). Plans were evaluated on the basis of the following methodology. Individual policies were evaluated and scored on a 0-2 ordinal scale. A score of "0" means that the policy is not mentioned in the plan. A score of "1" means the policy is considered but with no detail or it is optional to the plan; and a score of "2" means that the policy is fully considered or mandatory. The score shows the quality of the flood mitigation policies adopted in the local comprehensive plans. A higher score reflects a higher quality of flood mitigation policy.

To measure policy performance, the policy's breadth and depth score were calculated. The measurement technique of the policy scores is based on previous studies (Godschalk et al., 1999; Brody, 2003b; Tang, 2008; Kang et al., 2010; Tang et al., 2010). The breadth score of a specific policy measures the proportion of the plans that includes the policy among all plans. This measurement is very useful to evaluate to what degree local governments integrate a specific policy in their plans. The policy depth score can measure the detail or

degree of strength by identifying which local governments mention the specific policy. Depth score is measured by two methodologies. The first method is to calculate the average score a policy received across all plans (53 plans) and the second depth score assesses the average score for plans which address the policy. This study calls the former *depth 1* and the latter *depth 2*. The depth scores have a range of 0 to 2 like the policy evaluation scheme. While a score of 0 means that a policy is not addressed in the plans, a score of 2 indicates that a policy is mentioned with detailed coverage in the plans. A score of 1 suggests that a policy is just mentioned without detailed information. It might be reasonable to assume that a depth score of around 1.5 would reflect a reasonable or acceptable level of quality (Kang et al, 2010).

To increase reliability, the plan coding and coding guidelines were well prepared and pretested (Shadish et al., 2002). To assess the reliability of the plan evaluation, a Cronbach's Alpha was tested. Cronbach's Alpha measures consistency among individual items by measuring how well each item in a scale is correlated with the sum of the remaining items. In this study, the Cronbach's Alpha was 0.874 which is widely acceptable to be reliable.

IV. Results

1. Flood Mitigation Policy Quality

The mean score for total flood mitigation policy quality of the 53 sampled plans is 38.55 points, which represent 35.69% of possible points (Table 2). This mean score is not very high and it can be inferred that sample jurisdictions have not been able to effectively incorporate flood mitigation policies into their local comprehensive plans. Also, the qualities of flood policy varied considerably across the 53 jurisdictions (Standard Deviation = 12. 58, Min. = 6 and Max. = 66). Overall, Pasco County received the highest score (66 of 108 points) in the total quality of flood mitigation policies which represents 61.11% of possible scores. In contrast, the City of Sweetwater (9 of 108 points) and City of Miami Springs (6 of 108 points) are among the lowest scoring plans in the study sample. Furthermore, the mean total policy quality of 27 coastal communities(45.74 of 108) is much higher than the

mean score of flood policy quality adopted in 26 non-coastal communities (31.08 of 108). The t-test result ($T=5.20$, $p<.01$) suggests that there is significant difference in means of total policy quality between them.

Table 2 Flood Mitigation Quality Assessment

Component	# of Policies	Mean Score (%)	Min.	Max.	Standard Deviation	Possible Max. Score (%)
General policy	2	3.30 (82.55%)	0	4	1.14	4 (100%)
Land use and zoning tool	5	4.34 (43.40%)	0	8	1.92	10 (100%)
Site design tool	5	4.25 (42.45%)	0	9	2.28	10 (100%)
Building standard tool	3	2.75 (45.91%)	0	4	1.24	6 (100%)
Acquisition tool	5	1.75 (17.55%)	0	7	1.63	10 (100%)
Incentive-based tool/taxing tool	3	0.42 (6.92%)	0	2	0.66	6 (100%)
Insurance tool	2	1.19 (29.72%)	0	4	1.18	4 (100%)
Structural tool	10	4.53 (22.64%)	2	9	1.74	20 (100%)
Awareness/Educational tool	7	2.74 (19.54%)	0	13	2.24	14 (100%)
Public facilities and infrastructure	3	3.25 (54.09%)	0	6	1.69	6 (100%)
Emergency/Recovery preparedness	3	3.08 (51.26%)	0	6	2.46	6 (100%)
Natural resource/Sensitive area protection	6	6.96 (58.02%)	0	11	2.24	12 (100%)
Total Flood Policy Quality	54	38.55 (35.69%)	6.00	66.00	12.58	108 (100%)

In addition to the overall quality, the mean scores of the components have wide variations. "General policy" component earned 3.30 points which represent 82.55% of the

points possible for this component. This result indicates that local jurisdictions have made relatively strong efforts to include “Discourage development in floodplain areas” and “Consistency with other regulation, laws and plans related to flood management.” In contrast, the average score for “Incentive-based tool/taxing tool” was only 0.42 points which yields only 6.92% of the possible maximum score of 6 points. This fairly low score demonstrates a lack of attention to incentive-based or tax-based flood mitigation tools by local governments. “Public facilities/infrastructure,” “Emergency/recovery preparedness” and “Natural resource/sensitive area protection” received over 50% of possible points. “Land use and zoning tool,” “Site design tool,” and “Building standard tool” received less than 50% of their possible maximum scores.

On the other hand, “Insurance tool” received 29.72% and “Structural tool” earned 22.64% of possible scores. “Awareness/education tool” component did not receive enough attention - less than 20% of the possible score. Furthermore, “Acquisition tool” received relatively less attention as well as “Incentive-based/taxing tool,” which earned only 17.55% of the possible maximum score.

2. Flood Mitigation Policy Performance Analysis

The first component, “General policy,” was mentioned in a relatively high percentage of plans. Research result shows that 89 % of plans addressed flood mitigation policy through land use by discouraging development in floodplain areas. Also, there is wide spread mention regarding consistency with other regulations, laws or plans (81%). The depth scores are also very high. Most local comprehensive plans discussed basic ideas of flood mitigation through land use and consistency with other regulations or plans with strong terms.

Policies for “Land use and zoning tool” are related to the regulation of land development in floodplains and conservation of floodplains and wetlands. To regulate development, permits and zoning are commonly used tools. While land use permits in floodplains (81%) and permit regulations in wetlands (85%) were frequently used tools in local comprehensive plans, only 17% of jurisdictions used an overlay zone with reduced density provisions. In addition, over half of the plans (58%) mentioned low density conservation of flood risk

areas. Low density conservation and overlay zones with reduced density provisions did not receive high *depth1* scores. However their *depth2* scores (over 1.6) are comparatively high. This means that these policies are ignored by many jurisdictions, but if they are mentioned, the qualities of detailed coverage are usually good. It is noteworthy that down zoning of floodplain was not presented in any local comprehensive plans. Where density has already been decided in a local plan, down zoning to lower densities is likely to face strong opposition.

With respect to “Site design tool,” 87% of sampled plans mentioned setback/buffers from floodplains and environmental sensitive areas and 74% of plans discussed site plan reviews related to flood mitigation and management. It is interesting that over half the plans (58%) mentioned cluster development to keep development away from floodplains, but this policy’s depth scores are comparatively low. This means that even if they addressed the cluster development policy, they did not address detailed information or did not use strong terms. On the other hands, 40% of plans mentioned a policy regarding special study or impact assessment for development in floodplain and 23% of plans mentioned subdivision regulation for flood mitigation. The plans which include those policies tended to give a comparatively detailed information, but this was not across the all evaluated plans.

Regarding building standards/building code, 75% of jurisdictions have the policies of building codes or building standards for flood mitigation in their plan and 79% of communities mentioned retrofitting or strengthening structures to meet current codes or regulations. Most plans that mentioned this policy focused on minimum elevation and building design standards which are required by FEMA. On the other hand, no plan included a flood mitigation policy to use low interest loans to retrofit structures.

Acquisition tools have had very limited use by local governments. Half of the plans (51%) in the study sample mentioned land and property acquisition such as fee simple purchase for flood management with less detailed information (*depth1* of 0.68 and *depth2* of 1.33). 40% of plans discussed transfer of development right (TDR) of floodplains or environmentally sensitive areas. And only 6% of plans mentioned purchase of development rights (PDR) and 23% of plans mentioned dedication of open space or easement for flood mitigation and relocation of vulnerable structures away from flood prone areas. No policy

among the five acquisition tools received over 1.5 points in depth scores and this result suggests that plans used these policies more optionally than required.

Among the three incentive and tax based flood mitigation policies, a density bonus policy was mentioned in 25% of plans and only 9% of plans addressed a policy of impact fees for flood mitigation. Plans rarely discussed tax abatement for mitigation (4%). Nevertheless, it is true that incentive tools can be used to encourage stakeholders to implement flood mitigation policies rather than force them.

Over half of the plans (58%) discussed the communities' participation in flood insurance programs, but a few plans (8%) mentioned participation in the Community Rating System (CRS) in their plans. While a very small number of jurisdictions paid attention to CRS, they offered detailed information with strong support (*depth2* of 2).

Because policies regarding flood mitigation structures are mainly considered in other plans such as hazard mitigation plans or other projects based plans, the overall scores regarding specific structural tools are not good except for detention/retention and stormwater management measures. Detention/retention or storm water management measures are important parts of urban infrastructure. Thus, all local comprehensive plans (100%) provided excellent details using strong terms regarding storm water management (*depth1* of 2).

Although education and outreach programs for flood mitigation have been recognized as inexpensive but effective tool, these received little attention by local jurisdictions with a 30% breadth score in this study. 4 % of plans addressed real estate hazard disclosure but when addressed, plans offered detailed information (*depth2* of 2). A comparatively large number of communities (74%) mentioned that they have used and maintained floodplain maps.

Capital improvement policy was adopted by most jurisdictions (94%) to improve or develop drainage facilities or storm water management facilities which affect flooding indirectly and directly. 45% of communities among the 53 study areas adopted a policy for monitoring/retrofitting public structures for flood mitigation, often with good detail (*depth2* of 1.55), but this did not occur across all plans (*depth1* of 0.7). A relatively high percentage (75%) of plans included a policy for not locating public facilities in flood risk zones by limiting public expenditures in risk areas with a good detail (*depth2* of 1.88).

"Emergency/recovery preparedness" component is critical for coastal management element. About 60% of local plans addressed evacuation/shelter preparedness, emergency plan preparedness and recovery plan preparedness, often times with good detail (*depth2* range between 1.02 and 1.04).

Not surprisingly, most plans (94%) encompass the general idea of the importance of natural resources and sensitive area protection for preserving natural drainage functions and mitigating floods through the "Conservation element," "Land use element" or "Open space element." Also, wetland conservation and restoration from physical and hydrological alteration was adopted by most plans (94%) with good detail and comparatively strong terms(*depth1* of 1.2 and *depth2* of 1.82). Similarly, a majority of local plans (94%) mentioned a sediment and erosion regulation policy relatively well (*depth1* of 1.77 and *depth2* of 1.88), indicating that they recognized the importance of erosion control for protecting streams and drainage systems from substantial alteration of their natural functions. About 70% of plans discussed forest and vegetation management, often in good detail (*depth2* of 1.58). Dune protection got attention from 34% of communities and only 11% of study jurisdictions suggested stream dumping regulations.

Table 3 Breadth and Depth Analysis of Flood Mitigation Policies

Policies		Breadth (0-1)	Depth 1(0-2)	Depth 2(0-2)
1. General Policy	1.1. Discourage development in floodplain areas	0.89	1.72	1.94
	1.2. Consistency with other regulations, laws or plans (i.e. flood ordinance)	0.81	1.58	1.95
2. Land use and zoning tool	2.1. Permitted land use	0.81	1.45	1.79
	2.2. Wetland regulation using permit	0.85	1.64	1.93
	2.3. Low density conservation	0.58	0.96	1.65
	2.4. Overlay zone with reduced density provisions	0.17	0.28	1.67
	2.5. Down zoning of floodplains	0.00	0.00	0.00
3. Site Design tool	3.1. Site plan review	0.74	1.21	1.64
	3.2. Special study/impact assessment for development in floodplains	0.40	0.60	1.52
	3.3. Setbacks/Buffers	0.87	1.40	1.61
	3.4. Cluster development to keep development away from flood zones	0.58	0.70	1.19

Policies		Breadth (0-1)	Depth 1(0-2)	Depth 2(0-2)
	3.5. Subdivision regulation	0.23	0.34	1.50
4. Building standard tool	4.1. Building standards/Building code	0.75	1.23	1.63
	4.2. Strengthening of structures to meet current codes or regulations (i.e. elevation)	0.79	1.53	1.93
	4.3. Low interest loans to retrofit structures	0.00	0.00	0.00
5. Acquisition tool	5.1. Land and property acquisition (fee simple purchase)	0.51	0.68	1.33
	5.2. Dedication of open space for hazards/Dedication of conservation easement	0.23	0.28	1.25
	5.3. Transfer of development rights	0.40	0.42	1.05
	5.4. Purchase of development rights	0.06	0.08	1.33
	5.5. Relocation of vulnerable structures out of hazard zones	0.23	0.30	1.33
6. Incentive-based tool/ Taxing tool	6.1. Impact fees	0.09	0.09	1.00
	6.2. Tax abatement for using mitigation	0.04	0.04	1.00
	6.3. Density bonus	0.25	0.28	1.15
7. Insurance tool	7.1. Participation in flood insurance programs (NFIP)	0.58	1.04	1.77
	7.2. Participation to Community Rating System (CRS)	0.08	0.15	2.00
8. Structural tool	8.1. Detention ponds/retention/holding	0.72	1.28	1.79
	8.2. Levees	0.00	0.00	0.00
	8.3. Dams	0.00	0.00	0.00
	8.4. Seawalls	0.11	0.13	1.17
	8.5. Riprap	0.17	0.17	1.00
	8.6. Bulk heads	0.09	0.09	1.00
	8.7. Channel maintenance/Channelization	0.11	0.15	1.33
	8.8. Slope stabilization	0.04	0.04	1.00
	8.9. Storm water management	1.00	2.00	2.00
	8.10. Clearing of debris	0.49	0.66	1.35
9. Awareness/ Educational tool	9.1. Education/outreach program	0.30	0.43	1.44
	9.2. Real Estate Hazard Disclosure	0.04	0.08	2.00
	9.3. Flood forecasting, warning and response program	0.04	0.06	1.50
	9.4. Training/Technical assistance	0.15	0.23	1.50
	9.5. Maps of areas subject to flood hazards	0.74	1.32	1.79
	9.6. Computer models/evacuation systems (e.g. HEC, web-based modeling system)	0.09	0.11	1.20
	9.7. Database	0.38	0.51	1.35
10. Public Facilities and infrastructure	10.1. Capital improvements	0.94	1.13	1.20
	10.2. Monitoring/retrofitting public structure	0.45	0.70	1.54
	10.3. Policy not to locate public facilities in flood zones	0.75	1.42	1.88
11. Emergency/Recovery Preparedness	11.1. Evacuation/shelter preparedness	0.62	1.02	1.64
	11.2. Emergency plan preparedness	0.60	1.02	1.69
	11.3. Recovery plan preparedness	0.55	1.04	1.90
12. Natural resource/	12.1. General description of natural resource and sensitive area protection for flood mitigation	0.94	1.60	1.70

Policies		Breadth (0-1)	Depth 1(0-2)	Depth 2(0-2)
sensitive area protection	12.2. Wetlands conservation/restoration	0.94	1.72	1.82
	12.3. Dune protection	0.34	0.58	1.72
	12.4. Forest and vegetation management riparian areas	0.70	1.08	1.54
	12.5. Sediment and erosion control regulation	0.94	1.77	1.88
	12.6. Stream dumping regulations	0.11	0.21	1.83

V. Discussion and Policy Implications

1. Summary of Findings and Implications

Floods pose the greatest threat to the property and safety both in the US and Korea. Planning researchers (Burby, 2005, 2006; Godschalk et al., 1998) have faith that losses from floods can be reduced if governments address this issue and adopt appropriate policies in their plan. As a starting point of examining this idea, this research assessed the ability of local governments to incorporate flood mitigation policies in local comprehensive plans of Florida.

First of all, this study found that the mean score for total plan qualities with regard to flood mitigation is 35.69% of the possible points. This score is not very high and indicates that there is still considerable room for flood mitigation in local communities. The scores of plans varied widely from one jurisdiction to another. It means that the steps taken to reduce flood damage are not evenly adopted and implemented across all jurisdictions. Coastal communities received significantly higher scores than inland communities. This suggests that geographical vulnerability to floods and hazard experience of coastal communities influence the quality of flood mitigation policies.

In addition, this study found substantial variations in the scores of each policy. While most communities in Florida adopted land use management tools such as permitted land use in floodplain areas and wetland permits as primary flood mitigation tools, incentive-based tools/taxing tools and acquisition tools such as impact fees and tax abatement were rarely adopted by local jurisdictions. This result indicates that in the United States, flood mitigation through land use management gained widespread acceptance at the local level due to its effectiveness and reduced financial burden. The floodplain maps which FEMA

produced for flood insurance provided evidence and criteria for land use regulation.

The low scores associated with structural tools stem from the cause that comprehensive plans are more focused on non-structural policies such as zoning and land use management. Natural resource/sensitive area protection tools, such as wetland conservation and sediment and erosion control regulation were more often adopted in comparison to awareness/education tools. Local communities tend to prefer natural resource/sensitive area protection tools because of their multi-benefits such as biodiversity, sustainability, climate change adaptation.

The analyses found that communities tend to focus on a narrow set policies at the expense of other tools which could be more effective in flood mitigation. Preparing powerful and suitable instruments encourages to minimize losses caused by floods. Thus, communities need to find a proper combination of policies that are effective for local conditions by including other policies.

2. Applicability of Research Methodology to Environment and Hazard Research in Korea

This study extended the existing literature on plan quality evaluation and hazard mitigation research by evaluating the extent to which Florida local governments have incorporated flood mitigation policies in their plans using plan evaluation methodology. While various studies in the US have examined plan quality focusing on various issues, little research has been done in Korea. One reason might be the fact that Korean planners are more interested in planning process and physical design than plan quality. A plan is a document and an outcome of the planning process. Also, it is an important indicator of planning efforts and adopted plans have wide-range of powers to influence many important aspects of community life (Brody et al., 2011; Berke and Godschalk, 2009). Thus, plan quality concept and methodology offer an objective and straightforward tool for studying plan quality and guiding plan preparation.

The plan quality evaluation can be applied to various environmental topics in Korea. In particular, sustainability, climate change, natural hazards, and principles of strategic environmental impact assessment can be critical topics for applying plan quality

methodology. The analyses will give meaningful insights to understand how well current Korean plans advance these issues. For evaluating these issues, researchers will define dimensions covered, develop evaluation protocol (criteria) by incorporating main principles and practices of each topic into dimensions, and then measure plans against the protocol using quantitative scheme. Quantitative results can be compared and tested statistically (Berke and Godschalk, 2009). Furthermore, considering widespread usage and significance of plans, the plans need to be routinely evaluated against accepted plan quality standards.

The evaluation concept and protocol in this study can be directly applied to Korean plans to indicate how well local plans integrate flood mitigation policies and which communities have serious considerations for flood mitigation. The developed protocol, which is a set of existing and best flood mitigation policies, can serve both as an evaluation criteria and guidance for local jurisdictions to include a wide range of policies. As a pilot trial, this study applied the protocol to plans of Korean seven metropolitan cities (Seoul, Pusan, Taegu, Gwangju, Ulsan, Incheon, Daejeon) for getting a snapshot of Korean flood policies and identifying applicability. The assessment and implications follow.

3. A Pilot Analysis for 7 local plans in Korea and implications

As mentioned above, Korea has similar institutional backgrounds with Florida. Korea requires all local governments (Si/Gun) to develop basic urban plans like local comprehensive plans of the United States under the "National Land Planning and Utilization Act."

In Korea as elsewhere, structural approaches mainly addressed in flood management plans along river basin, have dominated flood management. But since 1990s, following international trend which flood mitigation through land use planning has become emphasized, the "disaster prevention and safety" has been an element of the plans (Kim, 2005). This element mainly addresses flood mitigation policies. Like Florida, basic urban plans in Korea also include land use, transportation, infrastructure, park and reservation, natural resource management, industrial and economic elements to guide future development and growth. A difference between Florida local plans and Korean urban plans is that Florida

has only a level of local comprehensive plan compared to that Korea has two levels; basic urban plan and urban management plan.

As a pilot analysis, seven metropolitan basic urban plans were evaluated against the developed protocol and the only breadth score of each policy was calculated. It is noteworthy that it is difficult to compare and analyze cities of Korea directly against the analysis on US cities due to differences of selected sample size, jurisdiction's population size and hazard experience and other factors. However, this pilot study can test applicability of the methodology and the policy breath scores provide simple snapshot regarding which policies are more adopted and implemented at the local level in the Korea.

As seven metropolitan cities of Korea have much more resources and capacities than other korean communities, it is assumed that their plan qualities might be higher than other korean local plans. But their overall mean breadth scores were much lower than the scores of Florida local plans.

Breadth analysis assessing how broadly each policy address indicates that sampled korean local governments tend to adopt a narrow range of policies. Among 54 possible flood mitigation measures, only 20 were adopted and implemented. Most sampled plans recognized the general idea that land use can be an important tool for flood mitigation but concrete and actual regulatory tools such as downzoning, wetland regulation, density regulation, overlay zone, setback, cluster development were not chosen. While specific land use regulatory tools have gained widespread acceptance at the local level in the US, they are still not commonly accepted in Korea. In addition, while flood mitigation using natural resource/sensitive area protection tools is often adopted in the United States due to their multi-benefits, korean local governments pay less attention to them. Research (Brody et al., 2011) found that setbacks, buffers, and "pocket" protected areas are particularly effective for flood mitigation because these actions keep people and properties away from the most vulnerable areas. Korean local governments need to pay more attention to these strategies as fundamental solutions. Also, acquisition tools and incentive based tools were not adopted at all (Table 4). Furthermore, regulating locations of public facilities and infrastructure tools as well as monitoring and strengthening them received little attention by local governments in Korea.

This results indicate that local governments in Korea do not pay enough attention to flood issue even if floods become worse with climate change. Also, they focus on a narrow range of policies such as awareness/educational tools and emergency/recovery preparedness tools. Thus, local governments need to diversify flood mitigation policies and identify policies suitable to their environments and situations. To diversify flood mitigation policies and achieving more effective flood mitigation, local governments in Korea need to adopt more wide range of policies including concrete regulatory land use tools, acquisition tools, natural resource/sensitive area protection tools and public facilities/infrastructure tools. In addition, as a preceding step of adopting various land use regulatory tools, flood risk maps with high resolution and precision should be ready. Environmental planning policies for preserving natural resource and sensitive areas need to be connected with flood mitigation and climate change issue. Plan and policy evaluation which is used in this study can be a critical process to identify current status of local policies and to find unadopted policies in spite to their effectivity and necessity. Thus, the evaluation process is quite helpful and necessary to identify flood strategies suitable to the locality.

This pilot study shows that the plan quality evaluation methodology is useful to identify current status of local efforts to flood mitigation and provides policy implications. Further study needs to extend its study areas to other local jurisdictions in Korea and examine detail plan qualities including depth scores.

Table 4 Mean Breadth Score by Component of 7 Korean Local Plans

Component	Mean Breadth Score (Florida plans)	Mean Breadth Score (Korea plans)	# of policies adopted in Korea/ # of Policies	Policies used in Korea
General policy	0.85	0.50	2/2	General description discouraging development in risk area, consistency with other plans
Land use and zoning tool	0.48	0.11	1/5	Flood risk zone management
Site design tool	0.56	0.11	1/5	Impact assessment for development in flood prone areas
Building standard tool	0.51	0.14	1/3	Strengthening structures in risk zone

Component	Mean Breadth Score (Florida plans)	Mean Breadth Score (Korea plans)	# of policies adopted in Korea/ # of Policies	Policies used in Korea
Acquisition tool	0.29	0.00	0/5	-
Incentive-based tool/taxing tool	0.13	0.00	0/3	-
Insurance tool	0.33	0.14	1/2	Participation in flood insurance program
Structural tool	0.27	0.13	2/10	Detention/retention, storm water management
Awareness/Educational tool	0.25	0.43	6/7	Education, flood forecasting, training, maps of flood hazards, computer system, database
Public facilities and infrastructure	0.71	0.19	1/3	Monitoring public structure
Emergency/Recovery preparedness	0.59	0.52	3/3	Evacuation, emergency plan, recovery plan
Natural resource/Sensitive area protection	0.66	0.26	2/6	General description, riparian areas management
Overall Mean Scores	0.47	0.21	20/54	

VI. Conclusion

Mileti(1999) argued that disasters are not simply acts of Gods, but they are largely due to the result of how we develop and design our community. In other words, flood damage can be mitigated through thoughtful flood mitigation polices and land use policies. This study found significant variation in the quality of adopted local flood policies and there is still considerable room for flood mitigation measures at the local level both in Florida and Korea.

In many cases, the most effective flood mitigation programs utilize a mixture of various mitigation techniques tailed to a specific local conditions. The plan quality evaluation employed in this study can give a chance to identify weakness and strength of local flood mitigation policies and provide meaningful information to improve current flood management.

However, this study has following limitations. First, the sample was limited to 53 plans

and further research should examine larger samples to generalize the results. Second, this analysis was limited to local comprehensive plans. Other types of plans addressing flood issues, such as natural hazards plans, flood management plans in river basin should also be the focus for the comprehensive picture of the flood management approach. Third, this study is limited to evaluating the quality of existing local plans. A high quality plan does not automatically mean a good action and successful outcome. Thus, further study need to examine the effectiveness of flood mitigation measures by connecting plan quality with implementation process and outcome.

This study conducted a pilot analysis to identify applicability to Korea and give a snapshot of 7 cities' attentions to flood issue. This pilot study should be an initial step in exploring flood mitigation. Further study should extend this methodology to other communities using proper sampling process and include more detail policy performance evaluation for both urban general plan and urban management plan. Also, as mentioned above, plan quality evaluation can be effectively applied to other topics such as climate change, natural hazards, and sustainability and the results will provide significant policy implications.

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