

적응 전략에 초점을 둔 수변 도시의 복원 계획 분석 및 비교

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Analyzing and Comparing Resilience Plans in Waterfront Cities: A Focus on Adaptation Strategies

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Abstract: Facing the global crisis of climate change, waterfront areas are experiencing a significant increase in property damages and casualties. In light of the climate change era, this paper aims to identify resilience strategies against rising sea levels and associated natural disasters. A comparison and analysis of resilience plans and strategies have been conducted for five waterfront cities. In conclusion, three key points are suggested. Firstly, establishing partnerships locally and globally is an emerging trend to effectively and collaboratively address climate change. Secondly, resilience is a fundamental concept in designing social, built, and cyber infrastructure, requiring attention from stakeholders. Lastly, designing a well-operating system is critical to respond effectively when external shocks or stress occurs.

키 워 드: 수변 도시, 적응 전략, 복원 계획, 100대 도시 복원 주도

Key Words: Waterfront Cities, Adaptation Strategies, Resilience Plans, 100 Resilient Cities Initiative

1. Introduction

In the era of climate change, we are confronted with escalating physical, social, and economic challenges that characterize the 21st century. The rise in sea levels poses a significant threat to the property and lives of urban areas. With thirty percent of the global population residing near waterfronts, such as ports, coastlines, and islands, these areas are increasingly susceptible to more frequent and severe damages. The incidents of disasters, particularly floods and inundations, are on a steep rise, directly linked to the escalating sea levels. It is imperative to develop strategies aimed at mitigating damages stemming from natural disasters associated with the climate crisis.

This discussion will delve into the definition of climate change and the concept of resilience, considering them as integral components of the highest degree of sustainable design. The concept of resilience will be examined in the context of urban planning and design, focusing on adaptation and mitigation strategies.

The paper will commence with an exploration of the '100 Resilient Cities initiative',

pioneered and supported by the Rockefeller Foundation (The Rockefeller Foundation, 2013). This initiative is dedicated to assisting cities worldwide in enhancing their resilience against the physical, social, and economic challenges prevalent in the 21st century. Among the 100 cities, 32 have presented urban resilient strategies. From this pool, five waterfront cities have been specifically chosen for a detailed comparative analysis of their mitigation and adaptation strategies.

2. Background

The proactive aspect of climate change pertains to long-term alterations in weather patterns within a specific region, often exceeding the statistical climate averages. Defined by the United Nations Framework Convention on Climate Change, climate change encompasses modifications in Earth's atmospheric constituents, attributed to both direct and indirect human activities, as well as natural variations in climate over time. Predominantly, global warming resulting from the utilization of fossil energy emerges as a principal contributor to climate change. The combustion of fossil fuels produces greenhouse gases, such as carbon dioxide, methane, and nitrous oxide, intensifying the atmospheric greenhouse effect. As the concentration of these gases rises, excessive absorption of

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radiant heat occurs, leading to an overall increase in Earth's temperature.

Elevated global temperatures contribute to the melting of glaciers, including those in Antarctica and the Arctic, revealing larger land areas that absorb more solar heat. This phenomenon results in thermal expansion of seawater and glacier melt, ultimately inducing global environmental changes such as rising sea levels and shifts in fauna and flora distribution. Over the last century, observed sea level rise has deviated from the historical average of 0.1-0.2 mm per year during the past 3,000 years since the last glacial period. According to the Intergovernmental Panel on Climate Change (IPCC), projected sea level rise is anticipated to be 7-36cm by 2050, 9-69cm by 2080, and 30-80cm by 2100 (Figure 1 & 2).

These forecasts of rising sea levels are anticipated to result in more extensive coastal flooding, accelerated shoreline retreat, and intensified natural disasters characterized by widespread rainfall and powerful winds. As of 2010, approximately 2.5 billion people, accounting for 39% of the global population, reside within 100km of coastlines, rendering them vulnerable to sea level rise-induced natural disasters, particularly flooding.

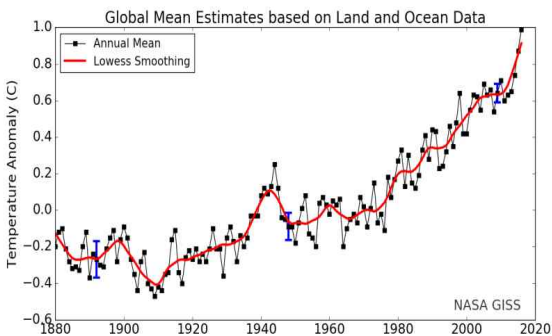


Figure 69. Rise of global temperature based on land and ocean. Source: NASA Goddard Institute for Space Studies

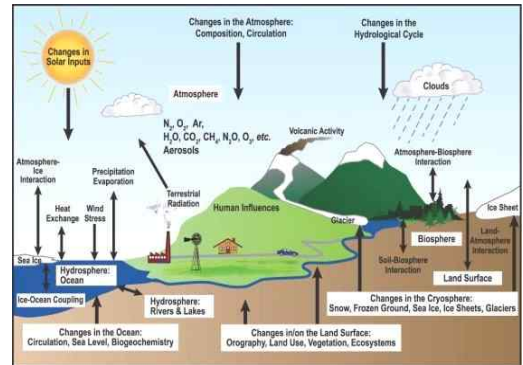


Figure 2. Schematic view of the components of the climate system, their processes and interactions. (Treut et al., 2007)

Against this backdrop, Choi (2016) conducted a study examining climate change response measures, specifically targeting pilot cities in Korea. The study extracted mitigation measures with notable greenhouse gas reduction effects and adaptation measures with substantial budget allocations. The investigation aimed to assess the impact of key climate change response measures on both mitigation and adaptation strategies. Furthermore, Kang & Park (2015) undertook an extensive inquiry and analysis of climate change strategies implemented by prominent cities in the United States. From this analysis, a strategy linking elements of carbon mitigation and adaptation planning emerged, which is deemed essential for informing future strategic responses to climate change. The emphasis was placed on identifying elements that warrant prioritized implementation. In light of these considerations, an examination of climate change response strategies with a specific focus on port cities—directly influenced by sea-level rise—holds promise for generating detailed, site-specific strategies and actionable measures.

3. Case Studies

3.1 Da Nang, Vietnam

Da Nang city has formulated strategic initiatives to undergo transformation with resilient infrastructure systems, enabling it to recover and effectively confront challenges in its development process. These strategies encompass twelve specific objectives, including: 1) Expanding floodwater drainage corridors and

establishing mechanisms for their management and restoration; 2) Evaluating flood risk in newly urbanized areas; 3) Adjusting plans that may impact drainage capacity; 4) Restructuring urban design in high flood-prone regions; 5) Relocating residential areas situated in floodplains or frequently affected by floods; 6) Developing a model for Da Nang’s flood-resilient communities; 7) Conducting research on energy efficiency in buildings to mitigate greenhouse gas emissions; 8) Researching the Quang Nam-Da Nang interregional river basin plan; 9) Investigating regional urban planning and management mechanisms; 10) Mitigating greenhouse gas emissions in waste treatment and tourism services sectors; 11) Implementing a green utility network in the water supply sector; and 12) Establishing monitoring and early warning systems for flood risk. Remarkably, collaborative and effective efforts have been observed among inter-city partnerships and international organizations, demonstrating a proactive response to the challenges posed by flooding(Figure 3).

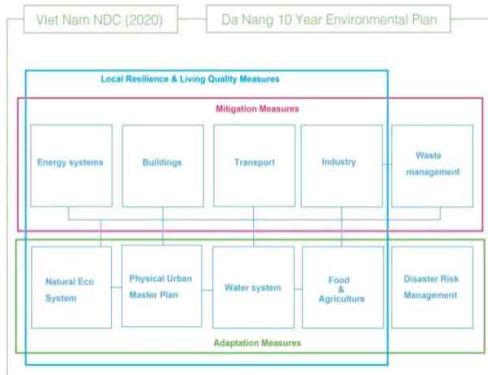


Figure 71. Da Nang City 10-Year Environmental Plan

3.2 Boston, United States

Boston has formulated neighborhood-based climate resilience plans designed to benefit households citywide while promoting environmental justice. A substantial number of Boston residents lack awareness of the specific climate change threats affecting their communities and are unaware of the simple and cost-effective strategies they can adopt to prepare for these challenges. Vulnerable populations, often bearing a disproportionate burden of climate change impacts such as

extreme heat and stormwater flooding, frequently lack access to essential information and resources for preparation. This initiative entails three specific objectives: 1) Engagement and Research, 2) Evaluation and Replication, and 3) Remediation and Reactivation of Brownfields.



Figure 4. Resilience Strategy Development

To initiate this process, Boston engaged with a diverse spectrum of individuals through meetings, workshops, and presentations, aiming to develop clear, actionable initiatives for fostering resilience in Boston (Figure 4). Climate change introduces significant shocks and stresses for Boston, especially as a coastal city susceptible to flooding and other damages associated with rising sea levels. Anticipating the impending stormwater flooding, Boston has developed a comprehensive plan, as illustrated in the accompanying map (Figure 5).

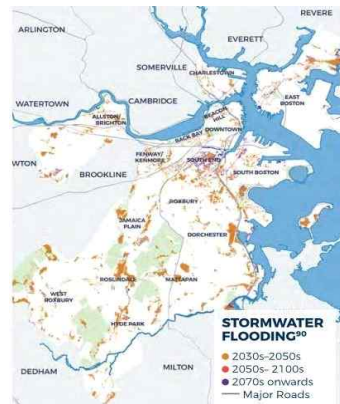


Figure 5. Expected Storm Water Flooding

3.3 San Francisco, United States

San Francisco is actively adjusting the city to align with the challenges posed by a dynamic and evolving climate. The threat of sea level rise to our waterfront and the increased frequency of intense storms, flooding, and extreme heat necessitate ongoing adaptation efforts. To address these challenges, three strategic initiatives have been formulated, and decisive actions are planned, including: 1) Development of a Sea Level Rise Adaptation Plan and 2) Launch of a Regional Waterfront Design Challenge. The Adaptation Framework, illustrated in Figure 6, establishes a systematic approach for continuous monitoring and assessment of ongoing efforts in a cyclical manner.

Figure 7 emphasizes the importance of simulation in predicting the location and volume of overflow water during storms or flooding events. Estimating the anticipated decline in property value over time provides a valuable tool for making well-informed decisions on how to strike a balance between the expenses of post-disaster relief and the upfront costs of adaptation measures.

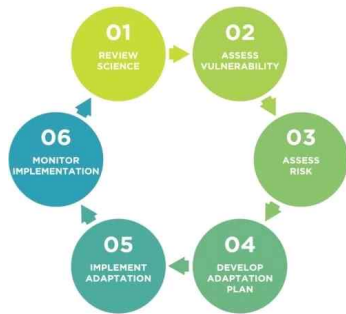


Figure 6. Adaptation Framework

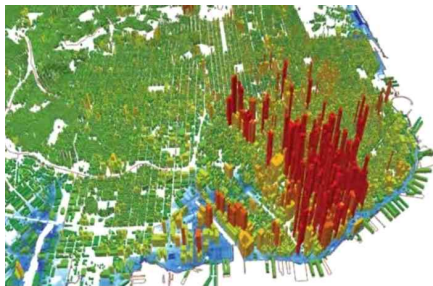


Figure 75. Three-dimensional view of downtown with 108-inch inundation, which shows sea level rise expected by 2100.

3.4 Rotterdam, Netherlands

All climate change projects and initiatives will be systematically assessed for their potential contribution to advancing the creation of a sustainable urban environment and fostering social cohesion, thereby enhancing Rotterdam’s resilience to water-related stresses and shocks.

As suggested in the Figure 8, this approach particularly underscores inclusiveness, encouraging the active participation of property owners, and emphasizes integration to align ongoing developments with water management strategies. Notably, three actions addressing resilience to rising water levels are outlined: 1) Water Sensitive Rotterdam, 2) Cyber Proof Water System, and 3) Adaptive Waterfront Development. The action plan strategically views flooding risks as opportunities to introduce integrative and inclusive approaches within the broader development plan. Additionally, it recognizes the close relationship between climate cyber resilience and critical infrastructure.

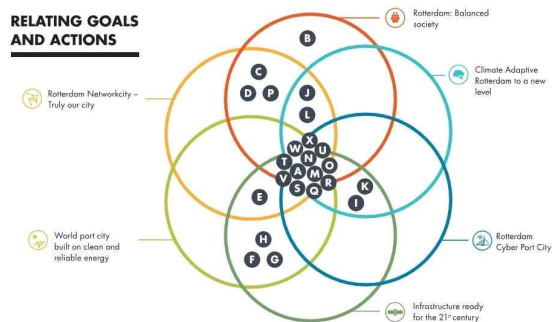


Figure 76. Diagram of goals and actions. Action J, K, L falls in the resilient design for rising water.

3.5 Toyama, Japan

Toyama, Japan, has set forth two primary objectives in its pursuit of resilience against flooding (Figure 9). Firstly, to devise comprehensive, resilient, and sustainable solutions, Toyama advocates for an initiative encompassing water, waste, and energy management. This integrated approach not only caters to the city’s future requirements but also addresses global environmental challenges, thereby fostering economic diversification into emerging sectors of the green and circular economy. Secondly, to enhance the resilience of critical infrastructure and ensure effective response during emergencies, four sub-initiatives have

been devised: 1) Embedding resilience as a fundamental principle in infrastructure design and maintenance, 2) Enhancing access to community infrastructure, 3) Improving flood control measures, and 4) Establishing community disaster management teams.

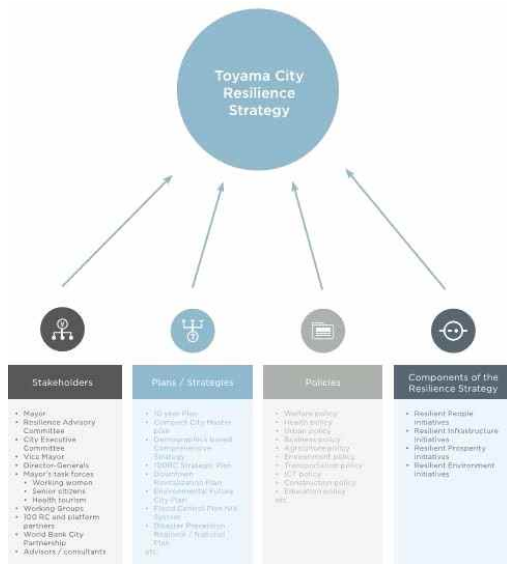


Figure 9. Toyama Resilience Strategy

4. Conclusions

In summary, these cities employ diverse strategies, ranging from community-centric approaches to comprehensive, integrated solutions, reflecting their unique contexts and challenges in addressing climate resilience. Implications for the South Korean Government based on the comparison of climate crisis adaptation strategies in the summarized cities include:

1. Integrated Approach and Collaboration:

- **Implication:** Recognizing the importance of an integrated approach, the South Korean Government may consider fostering collaboration between different departments and levels of government to address climate resilience comprehensively.
- **Action:** Establish cross-disciplinary task forces or collaborative platforms to integrate water, waste, and energy management initiatives.

2. Community-Centric Strategies:

- **Implication:** Learning from Boston's community-centric strategies, the South Korean Government could enhance public awareness and participation

in climate resilience efforts.

- **Action:** Implement community engagement programs, workshops, and educational campaigns to raise awareness and involve citizens in local resilience planning.

3. Strategic Initiatives and Continuous Monitoring:

- **Implication:** San Francisco's strategic initiatives and continuous monitoring suggest the importance of a long-term, adaptive strategy.
- **Action:** Develop a comprehensive climate resilience plan with strategic initiatives and establish a monitoring framework for ongoing assessment and adaptation.

4. Inclusiveness and Sustainable Urban Development:

- **Implication:** Rotterdam's emphasis on inclusiveness and systematic assessment aligns with sustainable urban development goals.
- **Action:** Integrate inclusiveness principles into urban development policies and systematically assess climate change projects for their contributions to sustainability.

5. Economic Diversification and Green Initiatives:

- **Implication:** Toyama's focus on economic diversification into green sectors presents an opportunity for the South Korean Government to align climate resilience efforts with economic growth.

- **Action:** Develop policies that encourage green and circular economy practices, providing economic incentives for businesses adopting sustainable practices.

6. Critical Infrastructure Resilience:

- **Implication:** Rotterdam's emphasis on critical infrastructure resilience can guide the South Korean Government in prioritizing infrastructure projects that enhance resilience.
- **Action:** Conduct vulnerability assessments for critical infrastructure, prioritize upgrades, and integrate resilience principles into urban planning.

7. International Collaboration:

- **Implication:** Da Nang's collaborative efforts with international organizations highlight the value of global partnerships in climate resilience.
- **Action:** Strengthen international collaboration and knowledge exchange by participating in global forums, sharing best practices, and seeking assistance from international organizations.

Incorporating these implications into policymaking

and urban planning can enhance South Korea's climate resilience efforts and contribute to sustainable development in the face of climate change challenges.

REFERENCES

The Rockefeller Foundation (2013), 100 Resilient Cities, Available from: <https://www.rockefellerfoundation.org/100-resilient-cities/> (accessed Dec. 23, 2023)

Treut, L. et al (2007), Historical Overview of Climate Change. In *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller Eds. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007; pp. 104-105.

The National Aeronautics and Space Administration (NASA) Goddard Institute for Space Studies, Available from: https://data.giss.nasa.gov/gistemp/graphs_v3/(accessed Dec. 23, 2023)

Choi, J. S. (2016), An Analysis of the Mitigation and Adaptation Effects of Change Climate Plans of Climate Change Pilot Cities in Korea, *Journal of Architectural Institute of Korea*, Vol. 32, No. 12., pp. 127~136.

Kang, Y. E. & Park, C. S. (2015), A Strategy of Combining Mitigation and Adaptation Planning and Evaluation of the Importance of Climate Change Response Plan, *Urban Design*, Vol. 16, No. 1., pp. 115~127.