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Outstanding Student Poster & PICO Contest

Efficient River Management Plan for Urban Flood Disaster Prevention

– Jae Yeong Lee*, Ho Jun Keum, Beom Jin Kim, Hyun Il Kim, Kun Yeun Han –

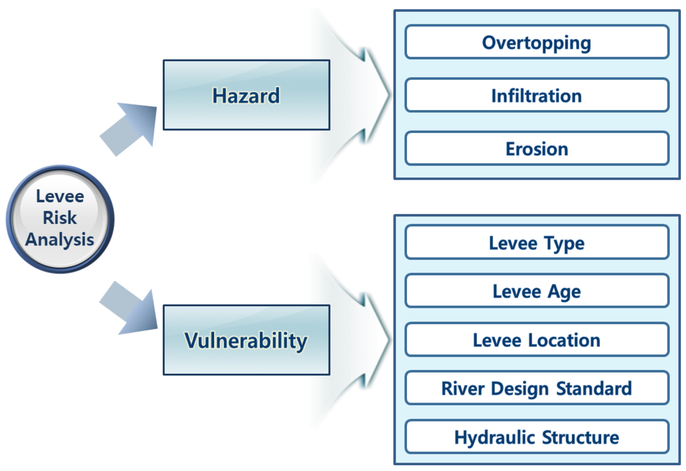
water9933@hanmail.net

Department of Civil Engineering, Kyungpook National University, Korea

Introduction

In recent years, inundation damage of rivers in major metropolitan cities has become a serious problem in Korea. In major national rivers, damage was reduced through a large-scale river maintenance planning by central and local governments, however, the maintenance of small and medium-sized rivers that pass through flooded cities has been was not successful. Therefore, a new approach to evaluating the safety of existing levee and selecting a flood hazard area along the river is needed.

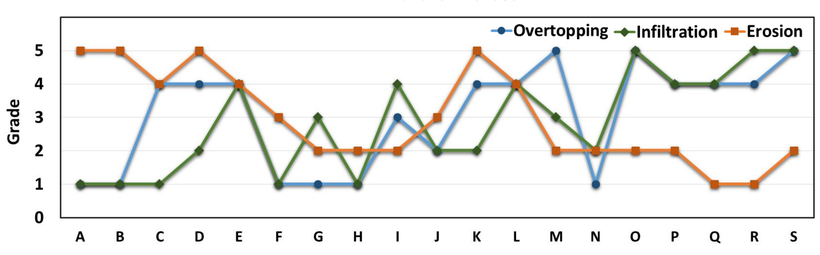
Therefore, in this study, we propose a methodology to predict the flood prone area by selecting high-risk levee for rational application of the levee overflow / failure scenarios. The high-risk levee is selected through the evaluation of the physical hazard(Hazard) of the levee using the hydraulic analysis results and the characteristics of the levee itself(Vulnerability). Furthermore, a specialist questionnaire was conducted to estimate the weight factors to be used for MCDM analysis of hazard and vulnerability.



- Flow chart of this study -

Hazard Analysis

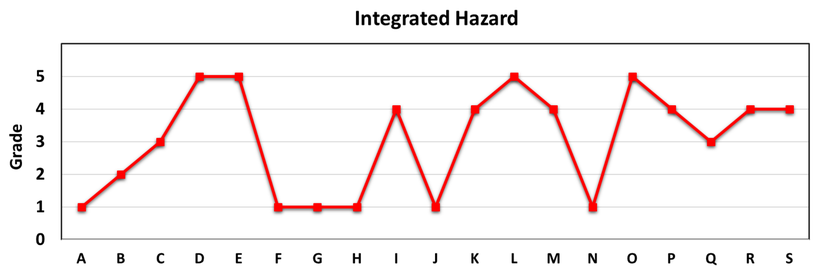
In order to evaluate the levee hazard, three items were evaluated: overflow, infiltration, and erosion. As a relative evaluation for prioritizing reinforcement for the levee in the stream, it was assigned to grade 1, which means the safest levee, and grade 5, which means the most dangerous levee.



- Result of levee hazard analysis -

Levee Hazard

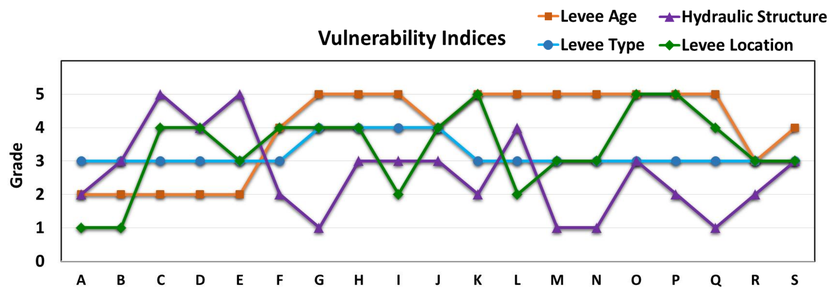
Using the MCDM method, we calculated the integrated levee hazard using the factors for overtopping, infiltration and erosion. Because it has different units and physical quantities, it is standardized as an index from 0 to 1.



- Result of Integrated levee hazard assessment -

Vulnerability Analysis

In order to evaluate the levee risk, the levee vulnerability analysis was carried out considering the physical characteristics related to levee. Considering the physical characteristics of the levee, such as the type, age, location, the compliance with river design standards, and the number of the hydraulic structures, each of them was assigned a vulnerability index.

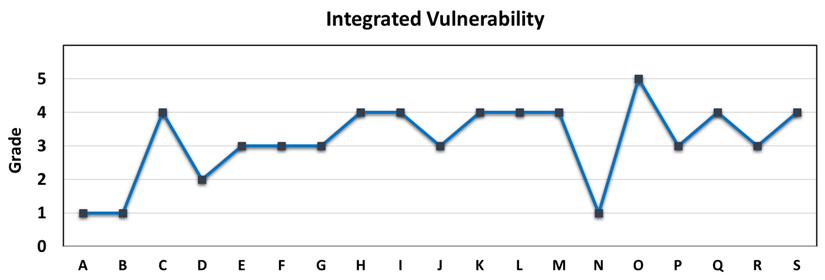


- Result of levee vulnerability analysis(w/o river design standard) -

- Result of levee vulnerability analysis(river design standard) -

Levee Vulnerability

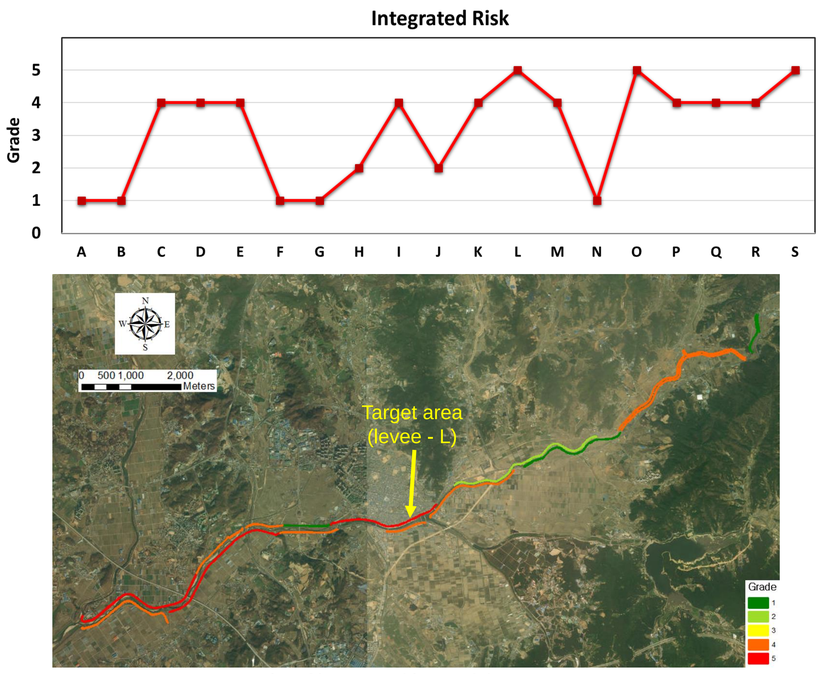
As with the hazard analysis, the MCDM was applied to evaluate the integrated vulnerability using five factors. In this case, grade 1 means the levee is not vulnerable, and grade 5 means the most vulnerable levee.



- Result of Integrated levee vulnerability assessment -

Levee Risk

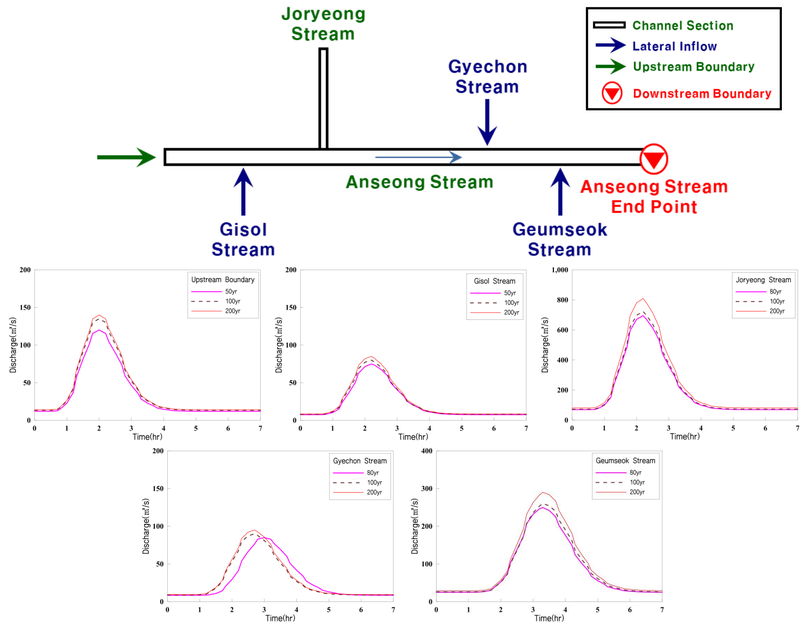
The risk, which is an index reflecting the integrated hazard and vulnerability, was calculated and classified into 5 grades. This means that the levee is likely to overflow and collapse due to floods, and the levee itself is vulnerable to damage, which is expected to cause damage.



- Results of integrated levee risk assessment -

Selection of River Flood Hazard Area

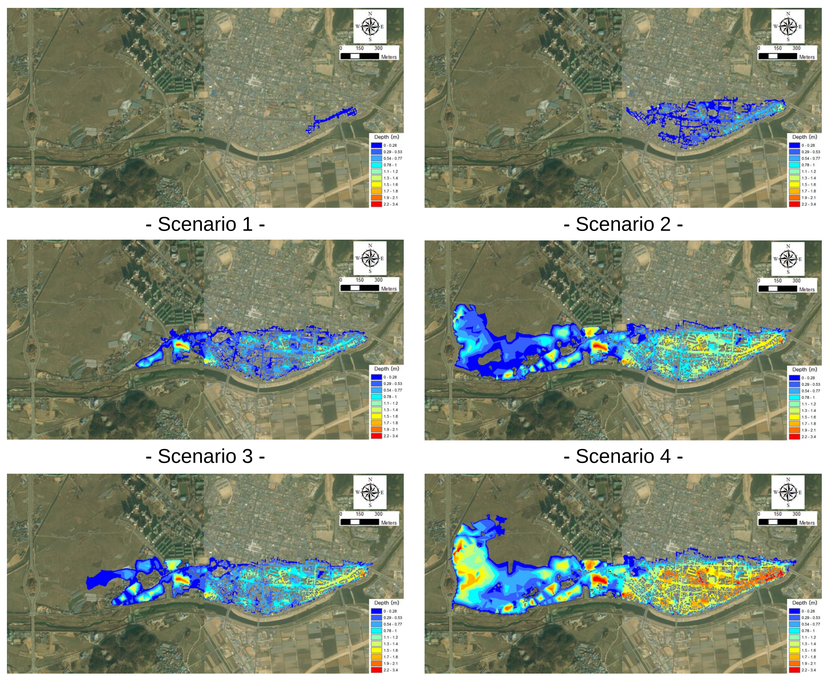
As a result of the levee risk analysis, we constructed the overflow and failure scenarios for the L levee that protect the urban areas with the highest risk. The FLDWAV and FLO-2D model was verified and the following six scenarios were constructed.



- Stream network for 1-D flood analysis and boundary conditions -

- Scenario Configuration -

Scenario	Return Period	Description	Breach Width (m)	Breach Duration (hr)
Scenario 1	80 year	Overtopping	-	-
Scenario 2		Breach	25	1
Scenario 3	100 year	Overtopping	-	-
Scenario 4		Breach	25	1
Scenario 5	200 year	Overtopping	-	-
Scenario 6		Breach	25	1



- Scenario 1 - - Scenario 2 - - Scenario 3 - - Scenario 4 - - Scenario 5 - - Scenario 6 -

- Flood prediction map by scenario -

Conclusion

In this study, levee risk analysis was conducted to link the physical hazard of the levee using the hydraulic analysis results with the vulnerability to the characteristics of the levee itself. This will give priority to the evaluation of the levee safety and reinforcement, and it will be possible to select the river flood prone area through the various scenarios for the overflow and failure of the levee due to the flood level which is higher than the design frequency of the river.

Acknowledgments

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