Advanced Science and Technology Letters
Vol.140 (GST 2016), pp.227-232
http://dx.doi.org/10.14257/astl.2016.140.44

A Spatial Unit Review of the Analysis on Disaster Vulnerability of Climate Change by Heavy Rain

Jong-Young Park[1], Jung-Sik Lee[2]

[1] Sambo Engineering co., Ltd, Professinal Engineer, 63 Daehak-ro, Gyeongsan city Gyeongsangbukdo, 38654, Korea
{Jong-Young Park, hydroen@hanmail.net}
[2] Department of Civil Engineering of Kumoh National Institute of Technology, Professor, 61 Daehak-ro, Gumi city Gyeongsangbukdo, 39177, Korea
{Jung-Sik Lee, jungsik@kumoh.ac.kr}

Abstract. Regarding the analysis on disaster vulnerability in accordance with climate change, this study reviewed the spatial analysis unit of climate exposure by adding dong-unit to census output areas. The analysis on climate exposure was divided into four stages by using Jenks Optimization of ArcGIS shown in the manual of analysis on disaster vulnerability of urban climate change (Ver 3.0). Regarding the climate exposure index, two indexes such as the number of average annual rainfall more than 80mm/day and the amount of average annual maximum hourly rainfall were used, and the current climate exposure indexes were only considered for the analysis. Regarding the climate exposure index values, the rainfall data of the Meteorological Agency nearby Gyeongsangbuk-do for last ten years was used for the analysis. In the results of reviewing the spatial analysis unit, the geographical distribution of climate exposure was differently shown in accordance with the characteristics of climate exposure index. The analysis through the census output area unit shown in the current manual and the analysis through dong-unit showed the aspect in which the direct influence area and indirect influence area were switched in each region. Thus, in the analysis on disaster vulnerability, the decision of spatial analysis unit for the characteristics of each disaster should be carefully made due to its usability for urban basic plan and urban management plan. More researches on the decision of spatial analysis unit should be continuously conducted in the future.

Keywords: Climate Change, Analysis on Disaster Vulnerability, Climate Exposure, Spatial Unit Analysis

1 Introduction

As an effort to cope with the recent climate change, there are disaster preventive policies aiming to reflect the characteristics of disaster vulnerability of each city to

[1] Corresponding Author:Jong-young Park Tel: +82-53-811-7200 email:hydrogen@hanmail.net

ISSN: 2287-1233 ASTL

urban basic plan and urban management plan when building up cities, getting out of the restoration-centered policies. The Ministry of Land, Infrastructure and Transport has distributed a manual of analysis on urban disaster vulnerability (National Urban Disaster Prevention Research Center, Ministry of Land, Infrastructure and Transport, 2013) since 2012. Suggesting total six types of analytical methods in each type of disaster, currently, it mainly focuses on rainfall disaster, so that additional complementation is required. This paper aims to suggest that the influence analysis on climate exposure in each type of disaster should be carefully done in the future, by suggesting problems of the analysis based on census output area as the basic spatial unit when analyzing disaster vulnerability shown in the manual above.

2 Subject Areas & Data Establishment

2.1 Subject Areas & Rainfall Observatories

The subject areas of this study were 22 cities/districts and the whole Gyeongsangbuk-do. Total 21 nearby weather stations under the Meteorological Agency influencing Gyeongsangbuk-do were selected. Table 1 shows the names of weather stations while the values in brackets mean the year of starting observation.

Table 1. Current Status of Climate Expose Indexes in Each Rainfall Observatory

Rainfall observatory	*Year to begin observation*	*Index 1 (80mm/day)*	*Index 2 (max.hourly rainfall)*
Geochang	1972	2.5	42.5
Gumi	1973	1.4	41.8
Daegu	1907	1.4	41.7
Munkyeong	1973	2.0	34.9
Milyang	1973	1.3	38.9
Boeun	1972	1.3	47.4
Bonghwa	1988	1.5	40.1
Andong	1973	0.9	38.2
Yeongdeok	1972	1.2	33.2
Yeongwol	1994	2.1	42.0
Yeongju	1972	2.6	38.0
Yeongcheon	1972	1.4	36.3
Ulsan	1932	2.1	39.9
Uljin	1971	2.1	30.3
Uiseong	1973	1.2	40.4
Jecheon	1972	2.8	51.2
Chupungyeong	1937	1.7	33.2
Chungju	1972	2.1	41.4
Taebaek	1985	1.9	37.0
Pohang	1944	1.5	41.1
Habcheon	1973	2.9	44.7

2.2 Meteorological Data

Extracting two climate exposure indexes for the analysis on disaster vulnerability such as the number of average annual rainfall more than 80mm/day and the amount of average annual maximum hourly rainfall, from the rainfall observatories above, the average values were applied. The data was based on the rainfall data for ten years from 2005 to 2014. Table 1 shows the number of average annual rainfall more than 80mm/day and the amount of average annual maximum hourly rainfall from the relevant observatories.

2.3 Spatial Unit Analysis Data

The data for spatial unit analysis was collected from SGIS Statistical Geographic Information Service(sgis.kostat.go.kr). Regarding the collected data, in the unit of census output area, Pohang-si was the highest (913 spots) while Yeongyang-gun was the lowest (29 spots). In dong-unit, Pohang-si was also the highest (29 spots) while Yeongyang-gun was the lowest (6 spots). In the results of reviewing census output areas in each area, the largest area was Uljin-gun(29,687.73ha) while the smallest area was Gumi-si(31.56ha). The average area was 2,786.80ha. The current status of spatial analysis unit is shown in Table 2.

Table 2. Basic Data Related to Spatial Unit

District	*Area (km^2)*	*Population (thousand)*	*section*	*Unit No.*	*District*	*Area (km^2)*	*Population (thousand)*	*section*	*Unit No.*
Gyeong Buk Do	18,980.7	2,559.3	Cences Dong	4491 328	Gun Wui	611.9	24.1	Cences Dong	30 8
Gyeong San	411.5	122.8	Cences Dong	445 15	Bong Wha	1202.8	33.8	Cences Dong	55 10
Gyeong Ju	1,325.2	259.8	Cences Dong	452 23	Seong Ju	614.9	45.0	Cences Dong	63 10
Gu Mi	615.7	419.9	Cences Dong	676 27	Yeong Deck	748.0	39.2	Cences Dong	61 9
Gim Cheon	1,005.7	140.1	Cences Dong	222 21	Yeong Yang	821.6	17.9	Cences Dong	29 6
Mun Kyeong	914.8	75.8	Cences Dong	116 14	Ye Chen	664.6	44.7	Cences Dong	78 12
Sang Ju	1,251.8	102.4	Cences Dong	171 24	Ul Jin	994.9	51.9	Cences Dong	83 10
An Dong	1,528.6	169.2	Cences Dong	307 24	Ui Seong	1169.4	54.5	Cences Dong	89 18
Yeong Ju	674.2	109.7	Cences Dong	176 19	Cheong Do	691.3	44.4	Cences Dong	65 9
Yeong Cheon	916.1	100.6	Cences Dong	166 16	Cheong Song	847.9	26.4	Cences Dong	43 8
Po	1,133.0	519.6	Cences	913	Chil	452.0	122.8	Cences	195

Hang			Dong	29	Gok	Dong	8
Go Ryeong	384.7	34.6	Cences Dong	56 8			

3 Results of the Analysis

The results of the spatial unit analysis on each climate exposure index of relevant cities/districts within Gyeongsangbuk-do are shown in Table 3 and Figure 1. Dividing census output areas from Dong- unit, total four zones were drawn. Just as shown in Figure 1, the results of analysis on census output areas and dong-unit showed relatively different values. Reviewing correlations between factors through the area of the relevant city/district, the number of census output area/number of dong, density of population, and the area of census output area/area of dong, there were no correlations between factors. The spatial analysis on census output area and dong-unit did not accord without showing a certain tendency. Therefore, additional researches would be needed in the future.

Table 3. Results Using the Spatial Unit Analysis

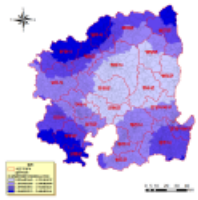
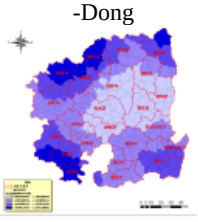
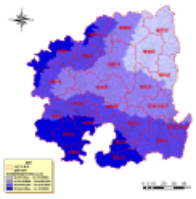
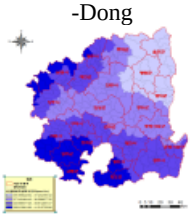
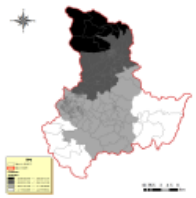
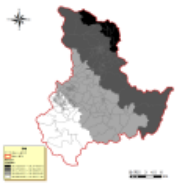
District	*Census/Dong ratio*	*Census area- Dong area ratio*				*Average*
		Zone 1	*Zone 2*	*Zone 3*	*Zone 4*	
GyeongSang Buk Do	13.7	1.0	0.3	0.3	1.7	0.8
Gyeongsan	29.7	2.6	13.0	21.7	37.3	18.7
Gyeongju	19.7	0.5	6.7	7.9	0.7	4.0
Gumi	25.0	11.7	12.4	19.5	4.6	12.1
Gimcheon	10.6	7.9	3.8	5.8	5.9	5.9
Muynkyeong	8.3	10.9	1.1	5.3	6.7	6.0
Sangju	7.1	2.3	6.3	6.1	2.1	4.2
Andong	12.8	9.1	21.7	3.0	15.6	12.4
Yeongju	9.3	5.2	7.4	3.7	8.9	6.3
Yeongcheon	10.4	12.0	12.9	6.1	7.0	9.5
Pohang	31.5	0.1	19.6	11.0	30.7	15.4
Goryeong	7.0	13.2	13.0	0.3	0.1	6.7
Gunwui	3.8	5.4	3.8	12.7	3.5	6.4
Bonghwa	5.5	8.4	7.3	1.0	2.1	4.7
Seongju	6.3	4.1	26.6	15.7	6.8	13.3
Yeongdeok	6.8	4.8	4.8	3.1	12.7	6.4
Yeongyang	4.8	1.2	11.2	12.4	0.0	6.2
Yecheon	6.5	4.7	0.2	0.7	5.6	2.8

Uljin	8.3	29.5	16.1	17.9	4.5	17.0
Uiseong	4.9	7.2	23.3	29.3	1.2	15.3
Cheongdo	7.2	4.7	7.9	17.7	5.1	8.9
Cheongsong	5.4	8.8	1.3	8.2	0.7	4.8
Chilgok	24.4	18.6	6.6	9.6	2.4	9.3

4 Conclusion

This study analyzed the spatial distribution of disaster elements through Dong and census output area spatial unit shown in the manual on the analysis of urban disaster vulnerability, and the conclusion is like below.

1. The geographical distribution of climate exposure in accordance with the characteristics of climate exposure index was relatively different depending on census output area and Dong-unit. The analysis through the census output area unit shown in the current manual and the additional analysis through Dong-unit showed the aspect in which the direct influence area and indirect influence area were switched in each city/district within Gyeongsangbuk-do.
2. Considering the usability for urban basic plan and urban management plan, the decision of spatial analysis unit for the characteristics of each disaster should be carefully made. More researches on the decision of spatial analysis unit should be continuously conducted to establish improvement measures.

The Number of average annual rainfall more than 80mm/day		*The amount of average annual maximum Hourly rainfall*	
Gyeonsangbukdo -Census	Gyeonsangbukdo -Dong	Gyeonsangbukdo -Census	Gyeonsangbukdo -Dong
			
Gyeongsan-si Census	Gyeongsan-si Dong	Gyeongsan-si Census	Gyeongsan-si Dong
			

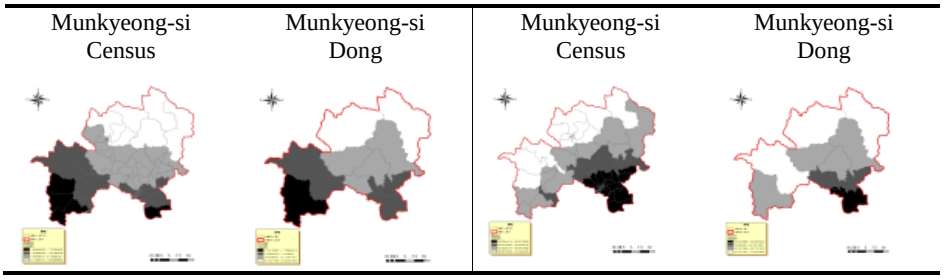


Fig. 1. Current Status of Spatial Analysis on Each Climate Exposure Index

References

1. Shim, W.B.: Manual on the Analysis of Disaster Vulnerability of Urban Climate Change (Ver 3.0), National Urban Disaster Prevention Research Center, The Ministry of Land, Infrastructure and Transport (2013).
2. Kim, J.S., Kim, H.Y., Lee, S.H.: The Review of Improvement Measures to Analyze Disaster Vulnerability of Urban Climate Change: Focusing on the Disaster of Sea Level Rise, Journal of the Korean Association Geographic Information Studies, pp.50~60 (2014).
3. Shim, W.B.: A Study on Development Measures for the Analysis on Disaster Vulnerability of Urban Climate Change, Korea Research Institute for Human Settlements (2013).
4. Kang, J.E., Lee, M.J.: Assessment of Flood Vulnerability to Climate Change Using Fuzzy model and GIS in Seoul, Journal of the Korean Association of Geographic Information Studies, vol. 15, no.3, pp. 119~136. (2012)