

## EXAMINING THE EFFECTS OF COMMUNITY'S SOCIAL CAPITAL ON DISASTER RISK IN SEOUL, KOREA

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### Abstract

Recently, unpredictable disasters around the world caused by abnormal climate and so on have consistently caused severe damage to our societies. Social capital has been researched that it plays a substantial role in enhancing community resilience in disaster settings. The objective of this study is to examine social capital level of community in Seoul regarding disaster risk reduction. For this purpose, we developed several indicators to measure social capital index based on the Seoul Survey data in 2017 and verified its validity using factor analysis. Moreover, we analysed the relationship between community's social capital and disaster damage in Seoul. The results of this study showed that community's social capital level has a negative relationship with disaster risk. It implies that communities with high social capital are more likely to reduce disaster risk and have faster recovery, further, this study is expected to help establish disaster management policies.

**Keywords:** Social Capital Index, Disaster Risk Reduction, Factor Analysis, Seoul

### Introduction

Unpredictable disasters around the world caused by abnormal climate change have consistently caused severe damage to our societies. In Korea, typhoon and rainfall have caused the most severe damage and from 2008 to 2017, they account for 90% of the whole type of disaster damage causes. In 2010, more than 40,000 people were dead or injured by rainfall and the total amount of property damage in 2011, Seoul were about 25million dollars. Even though Seoul is not considered as an area prone to all types of disaster, it is still highly exposed to meteorological disasters. Since 2015, for example, precipitation in Seoul tends to increase and the number of concentration rainfall occurrence which is over 30mm/h has been increasing. Seoul has been consistently exposed to disaster risks although the recent disaster did not cause much damage. Therefore, it seems to be clear that reducing disaster risk is still an important issue to be addressed.

There are plenty of approaches that have analysed the relationship with disaster risk reduction. It has been easily observed that many disaster risk managements have focused on the physical risk reduction method. As well as physical disaster risk reduction management, however, consideration of social aspects such as social capital has recently been highlighted in managing disaster. According to Dynes (2002), "disasters destroy all types of capital, human, economic, but social capital is the least damaged in a disaster and during the emergency period, social capital is the form of capital that serve as the primary base for a community response". Likewise, bonding social capital and community involvement play an important role in the prevention and recovery of natural disasters as well (Kim et al, 2017).

In Korea, however, studies regarding association between social capital and disaster risk reduction have been not much conducted yet. Thus, we tried to focus on the social capital as an efficient method to

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reduce disaster. The objective of this study is examining social capital level of community in Seoul regarding disaster risk reduction by developing several social capital indicators. Further, we attempt to analyse the relationship between community's social capital and disaster damage. Regarding objectives, this study would like to find answers following questions: 1) what does the community's social capital level look like? 2) what variables affect disaster risk damage? In this research, we review the definition of social capital, social capital index measurement and several empirical evidences that social capital plays a significant role in disaster response and recovery. Then, we move to our analysis methods including data and variable selections and measure social capital level of communities. Finally, we examine the effects of community's social capital on disaster risk in Seoul by multiple regression analysis.

## Literature Review

### Definition of social capital

Social capital has been defined as different ways by various scholars from Bourdieu, P. to Lin, N. Table 1 describes the definition of social capital by 5 scholars. According to Bourdieu (1983), social capital is 'the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition – or in other worlds, to membership in a group –.' Coleman (1988) defined social capital, explaining that how the social structure of a group can function as a resource for the individuals of that group. In other words, it is the structure of relations between actors. Further, Robert Putnam (1993) defined social capital is a feature of social organizations, such as networks, norms, a trust that facilitate action and cooperation for mutual benefit.

Some other scholars explained that social capital is divided into bonding social capital, bridging social capital and linking social capital. Woolcock, M (2002) insisted that we can measure social capital through three different types of ties – bonding, bridging and linking social capital. Bonding social capital is ties between immediate family members, neighbours, close friends and business associations who are sharing similar demographic characteristics but bridging social capital is ties among people from different ethnic, geographical, and occupational backgrounds yet with similar economic status and political influence. Linking social capital, lastly, means ties between community and those in position of influence in formal organizations such as banks, schools, housing authorities, or the police. Lastly, Lin Nan (2002) tied social capital to networks of relationships, defining it as resources embedded in one's social networks, and resources that can be accessed or mobilized through ties in the networks.

Table 1: Definition of social capital

Author	Definition of social capital
Bourdieu, P. (1983)	Network of more or less institutionalized relationships or to membership in a group
Coleman, J. (1988)	The structure of relations between actors and among actors
Putnam, R. (1993).	Features of social organizations, such as networks, norms, a trust, that facilitate action and cooperation for mutual benefit
Woolcock, M (2002).	Bonding social capital: ties between immediate family members, neighbours, close friends sharing similar demographic characteristics
	Bridging social capital: ties among people from different backgrounds but with similar economic status and political influence
	Linking social capital: ties between community and formal organizations
Lin, N. (2002)	Resources embedded in one's social networks, accessed or mobilized through ties in the networks

Generally, social capital is a resource that can be accumulated from social ties with others or organization, building trust and participation in political or social actions that contribute to mutual benefit. This social capital has been considered as an important asset to individual or community as an economic capital and human capital do.

### Social capital index measurement

Since social capital is an intangible concept, indicators are needed to measure it. However, it has been hard to set a standard of component for measurement indicators because social capital is mainly used as a broad concept and the way in which it is measured is different from the researcher or purpose of research. Thus, ways to measure social capital is diverse. Representatively, for example, the National Social Capital Community Benchmark Survey (SCCB) from Harvard University, which is the largest and the most commonly used survey of social capital also uses above indicators. Specifically, it assesses individuals' sense of belonging in community and friend groups; social and racial trust; participation in political events; membership in associations; informal social interaction. Based on the existing previous studies of social capital, we observed that 'participation', 'network', and 'trust' are the main indicators.

First component of social capital is 'participation', which is usually considered as civic engagement in political issue. For example, according to the SCCB, it measures political participation using several variables such as voting, signing a petition, attending political meeting, joining in demonstrations, boycotts or marches and even the respondent's interest in politics & current affairs. Volunteering also includes. Overall, participation indicates that how much respondents have interest in social issue or their community and how actively they engage in certain issue.

Second component of social capital is 'trust'. Barber (1983) defines trust as "socially learned and socially confirmed expectations that people have of each other, of the organizations and institutions in which they live that set the fundamental understandings for their lives." Specifically, trust can be assessed through several questions like "how much do you trust in your family, neighbourhoods, friends or co-workers?" Not only generalized trust but also institutional trust regarding public institutions, governments, police, etc. are used to measure trust.

The last component of social capital is 'network' which reflects ties between individuals. Individuals can be connected to others both informally and formally. First, the formal network indicates membership in groups such as religion, sports club, local community, NGOs, etc. Informal network indicates the interaction with family, friends or neighbourhoods and even the social support from others. In other words, network can provide more resources to solve some problems around individual or community and give more opportunity of supporting and assistance.

### Empirical evidences of social capital in disaster settings

Many previous studies explored that the relationship between the community' social capital and disaster, especially for the community resilience. It has been illustrated that communities with higher social capital showed the quickest recovery. Since social capital can provide warnings, disaster preparation, shelter and supplies, immediate aid and even initial recovery assistance (Hawkins and Maurer, 2010), building social capital within community can be an efficient method to reduce disaster damage and enhance community resilience in the post-disaster recovery stage. Likewise, throughout the sociological literature regarding disaster, research has shown that informal ties, particularly neighbours, are the real "first" responders who check on the well-being of others and provide immediate life-saving assistance following a disaster (Meyer, 2013).

There are a lot of empirical evidences around the world regarding how social capital can affect disaster damage. For example, study of Gujarat and Kobe earthquake in India and Japan uncovered that communities with high trust, norms participation, and networks were able to more quickly recover from disaster. According to the research by Nakagawa and Shaw (2004), "At every stage (rescue, relief, and rehabilitation), the communities played the most important roles among other concerned stakeholders". In other words, even though the communities differed in cultural and economic characteristics, communities with higher social capital and community leadership showed the highest satisfaction with community rebuilding and quickest recovery.

Likewise, in case of the Hurricane Katrina, Village de L'Est in New Orleans was able to return and rebuild more efficiently than less damaged and richer neighbourhoods based on both bonding social capital and the role of the Catholic Church in the community. In particular, the local church was able to share goods that supported coordinated in the community for recovery and political action to protect the area from outside redevelopment and zoning changes (Chamlee-Wright and Storr 2009). Furthermore, according to Haines et al (1996), members of social groups received more support following Hurricane Andrew. The Mary Queen of Vietnam community experienced resilience through charitable action by local and national organizations. That is, ties to social organizations can provide connection to an organization that can support through institutional channels like a church collecting money for a family in need.

In general, social capital has an important role to play in strengthening capacities at the community level for better risk reduction. Feelings of mutual trust and dependence within communities increased awareness of disaster management and volunteer opportunities and responsibilities, which in turn support disaster preparedness (Hausman et al., 2007). Thus, communities with higher levels of social capital and trust can better enhance the collective action of community and make their residents participate in presenting issues or directions compared to communities with the lower level of social capital and trust.

## **Methodology**

This study seeks to measure the social capital level of 25 local districts (gu) in Seoul then examine the association between social capital and disaster damage. In order to achieve this purpose, at first, we used factor analysis using PCA (Principle Component Analysis) method to measure the community's social capital level and its factors. Then, we used multiple regression model to examine how community's social capital affect its disaster damage.

### Data and variable selection

Data unit for this study is district in Seoul. The boundaries of Seoul's administrative districts are divided into 'gu' and 'dong' and the scale of 'gu' is larger than 'dong'. There are 522 dong in Seoul and the number of gu is 25. In fact, gu scale is not appropriate to measure community's social capital level since gu consists of several dong and average population of gu is usually over 0.1million persons. It is not available to obtain data from dong; however, we have no choice but to use gu district as a community for this study. However, since it is not available to obtain data from dong, we decided to use gu district as an analysis unit for this study.

The individual level data for this study were from Seoul Survey 2017, which is conducted by the Seoul Research Data service. Seoul survey is an annual survey to investigate the current state of Seoul, the quality of life and consciousness of citizens. Total 42,684 people's data are gathered. Based on this data, we developed total 11 indicators to measure community's social capital. We tried to develop social capital indicators with variables related to three main components of social capital: participation, network, and trust. Below table 2 shows which variables and questions are used for the social capital indicators. They include individual's membership in group, participation in civic engagement or decision-making process, whether respondents have any person when they are sick, feel depressed or need financial help and how much they trust in their neighbourhoods and public institutions. Except for two variables regarding trust measured on the Likert scale, other variables are measured on binary (1=yes, 0=no).

Additionally, we used more variables that can have influence on disaster damage as independent variables. Those variables were based on census data through KOSIS (Korean Statistical Information Service) and analysis unit is 'gu'. Each variable is categorized into socio-demographic, socio-economic and spatial variables. Female population (%), population over 70 (%) and population density were under the socio-demographic category. Socio-economic variables include basic livelihood security benefit recipients (%) and income. In case of income, particularly, the survey data was used for the 2017 Seoul Survey, unlike other variables, and the answer categories were re-constructed to match the income boundaries used mainly in Korea. In addition, we used four spatial variables: detached dwelling (%),

row house and apartment unit in a house (%), regional safety level and social welfare facilities per 0.1 million persons.

Table 2: Social capital indicators

Variable	Question
Volunteer	If you have a chance, are you willing to participate in volunteer activities?
Group membership	Have you ever participated in any groups in the past year?
Civil complaint	Have you suggested any civil complaint in the past year?
Political opinion	Have you written any political or social opinions online in the past year?
Seoul's policy project	Have you participated in Seoul's policy-related projects such as building community in the past year?
Policy proposal	Have you proposed any policy in the past year?
Social network_sick	Do you have any person (family, relatives, friends, neighbours, colleagues) who can help you when you are sick?
Social network_depressed	Do you have any person (family, relatives, friends, neighbours, colleagues) who can help you when you feel discouraged or depressed?
Social network_money	Do you have any person (family, relatives, friends, neighbours, colleagues) who can lend you money when you suddenly need a financial help?
Trust_neighborhood	How much do you trust in your neighbourhood?
Trust_public institution	How much do you trust in public institutions?

For dependent variables, we used disaster damage data from the ministry of the Interior and Safety. It includes both property damage data and casualties & victims from 2008 to 2017 by typhoon and rainfall. Both total amount of property damages and total number of casualties & victims caused by rainfall and typhoon for 10 years and their average data were used. Table 3 indicates the descriptive statistics of variables for this study, including 9 independent variables and 2 dependent variables.

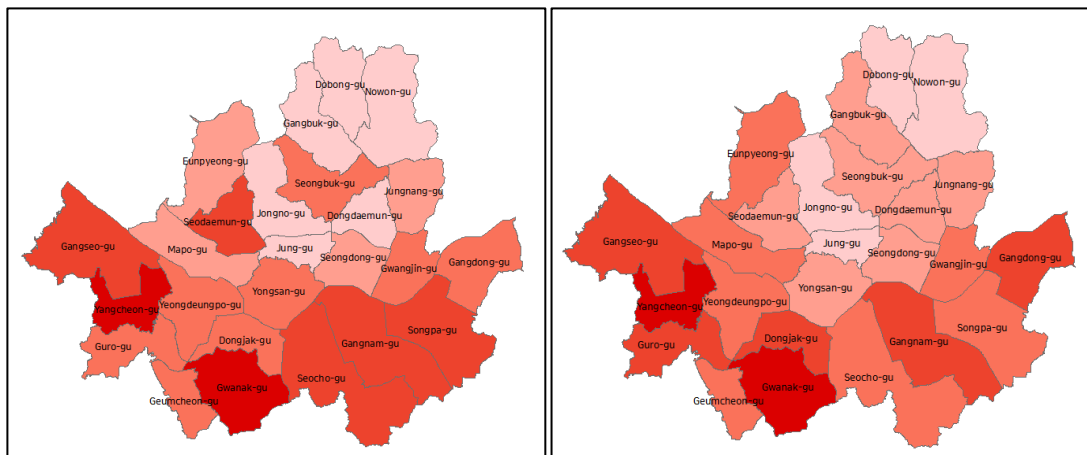


Figure 1: total amount of property damage (left), total number of casualties & victims (right)

Figure 1 shows the community's total amount of property damage and the total number of casualties & victims from 2008 to 2017 in Seoul by typhoon and rainfall. Yangcheon-gu and Gwanak-gu recorded the greatest damages among both damages among 25 communities in Seoul. Seocho-gu, Gangnam-gu

and Songpa-gu, which are commonly called ‘Gangnam area’ also got huge property damage but the number of casualties & victims were relatively small. Since these three communities are those with high incomes, the property value is way higher than other communities. Thus, it seems that the property damage is greater than the casualties and victims. Overall, southern areas of Han river got more damage than northern areas but both Jongno-gu and Jung-gu, which are in the centre of Seoul, got least damage.

Table 3: Descriptive statistics of variables

Variable	N	Mean	Standard Deviation	Min	Max
<b><i>Socio-demographic</i></b>					
Female Population (%)	25	51.149	0.879	49.085	52.969
Population over 70 (%)	25	8.689	1.150	6.934	11.306
<b><i>Socio-economic</i></b>					
Population density	25	16119.336	4606.498	6031.80	25360.50
Basic livelihood security benefit recipients (%)	25	2.739	0.897	1.176	4.767
Income	25	3.609	0.281	3.16	4.25
<b><i>Spatial</i></b>					
Detached Dwelling (%)	25	13.276	6.461	3.786	28.218
Row house & apartment unit in a house (%)	25	29.557	9.947	9.37	51.46
Regional safety level	25	2.24	0.926	1	4
Social welfare facilities (per 0.1million persons)	25	8.137	3.182	2.64	16.37
<b><i>Disaster damage</i></b>					
Total number of casualties & victims (2008-2017)	25	2815.12	2764.25331	23	10031
Total amount of property damage (2008-2017)	25	1536157.080	1666532.632	34778	6693448

- a. Response category of income: 1=less than 1million won, 2=over 1million – less than 2.5millions, 3=over 2.5millions – less than 4millions, 4=over 4millions – less than 6millions, 5=over 6millions – less than 8millions, 6=over 8millinos.

## Analysis

### Factor analysis

PCA is a method to reduce a large number of variables to a smaller number of composites (principal components) that represent the information in the data as closely as possible (Saukani & Ismail, 2018). This study has identified 11variables to be used in the construction of the social capital indicators. As the result of factor analysis by PCA, they were categorized into three principle components: participation, network, and trust. Table 4 describes the result of factor analysis and how each variable was grouped into each dimensions of social capital.

Under the first dimension of social capital, ‘participation’, total 6 variables were grouped; policy proposal, volunteer, civil complaint, Seoul’s policy project, political opinion and group membership. Cronbach Alpha of the factor 1 is 0.683. This dimension implies participation is a kind of combination among political participation, volunteer and membership. Three variables related to social network for different situation were grouped into the second factor, ‘network’, which has 0.653 Cronbach alpha( $\alpha$ ). This factor means how much people know each other and have a relationship with others well. Lastly, trust in neighbourhoods and public institution are categorized into ‘trust’ components.

Based on the result of factor analysis, we make each principle component scored. Since basic data unit is individual, it should be changed into community level (gu) to measure each community’s social capital level. First, we scored each factor and summed the three factor scores to create the final value of

social capital. Subsequently, the values of participation, network, trust and social capital were obtained and the average scores of each community were used as final variables to be used in regression analysis to examine the relationship with disaster damage.

Table 4: Result of factor analysis

Variable	Factor 1 <b>Participation</b>	Factor 2 <b>Network</b>	Factor 3 <b>Trust</b>
Policy proposal	0.864	0.078	0.038
Volunteer	0.817	-0.120	-0.031
Civil complaint	0.775	0.009	0.246
Seoul's policy project	0.724	0.304	0.100
Political opinion	0.724	0.173	-0.039
Group membership	0.711	-0.126	-0.057
Social network_sick	0.074	0.848	0.242
Social network_depressed	-0.199	0.810	0.091
Social network_money	0.232	0.697	-0.031
Trust_neighborhood	0.086	0.128	0.948
Trust_public institution	0.007	0.109	0.936
Cronbach Alpha( $\alpha$ )	0.683	0.653	0.902

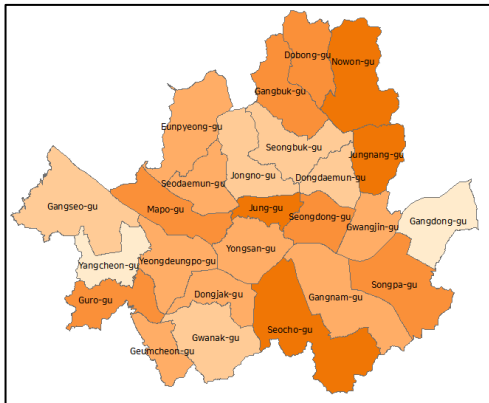
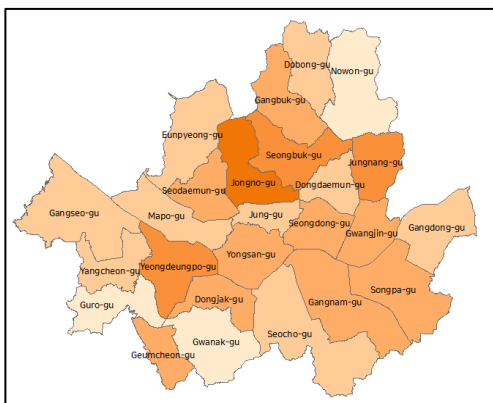


Figure 3: Community's participation level, Figure 4: Community's network level

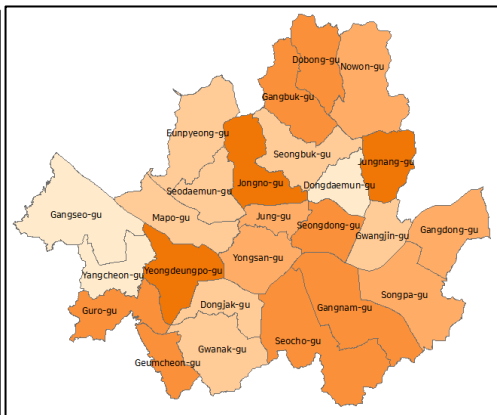
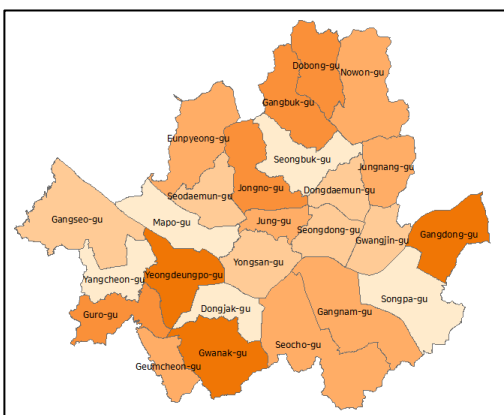


Figure 5: Community's trust level, Figure 6: Community's social capital level

Further, in order to analyse spatial pattern of social capital and its main component, we visualized each variable on map using ArcGIS. Above figure 3 to 6 indicates the community's three main components

and social capital level. As for the participation level, Jongno-gu, which is the centre of Seoul, recorded the highest score and overall, the southern districts of Han river especially for south-east side seems to get higher score. Spatial pattern of network seems that districts in the east side of Seoul have more network than west side. Yeongdeungpo-gu, Gwanak-gu and Gangdon-gu have highest score of trust. Overall, there seems to be no clear spatial pattern but districts in the south-eastern part of the Han River showed relatively higher levels of social capital than other districts.

Multiple regression analysis

With the variable of social capital and three factors obtained through factor analysis, a multiple regression analysis was conducted to investigate the relationship between disaster damage including property and casualties and social capital. We used total 11 variables as independent variables and two dependent variables. In case of the independent variables, they are divided into four categories: social capital, socio-demographic, socio-economic and spatial. We conducted four different analysis model with two types of dependent variables. First, the dependent variable was the average property damage for 10 years and all 11 independent variables were used. As a result, the model was not statistically significant. In addition, when the 10 independent variables except social welfare facilities were used, the results were not statistically significant either.

On the other hand, when we changed dependent variables from property damage to casualties & victims, both regression Model 1 and 2 were statistically significant. Independent variables of model 1 is 10 variables except social welfare facilities and those of Model 2 is all 11 variables. Also, to exclude the possibility of multicollinearity, three variables – participation, trust, and network – were used as independent variables except social capital variable. Table 5 describes the result of two regression models, and it shows each variable’s standardized coefficient and adjusted R<sup>2</sup>.

Table 5: Regression analysis result table

	<b>Model 1</b>	<b>Model 2</b>
Independent Variables	Standardized Coefficient	Standardized Coefficient
<b><i>Social Capital</i></b>		
Participation	-0.251*	-0.262*
Network	-0.418**	-0.529***
Trust	0.193	0.311
<b><i>Socio-Demographic</i></b>		
Female Population (%)	-0.099	-0.131
Population over 70 (%)	-0.472**	-0.332
Population Density	0.090	0.188
<b><i>Socio-Economic</i></b>		
Basic Livelihood Security Benefit Recipients (%)	-0.081	0.045
Income	0.017	0.085
<b><i>Spatial</i></b>		
Row House & apartment unit in a house (%)	0.306**	0.349**
Regional Safety Level	0.000	-0.114
Social Welfare Facilities	-	-0.367*
(Constant)	-	-
	(0.805)	(0.903)
N	25	25
Adjusted R <sup>2</sup>	0.656***	0.709***

a. Dependent Variables: Average number of casualties & victims (2008-2017)

\*p<0.1, \*\*p<0.05, \*\*\*p<0.01



As seen on the above result table, both Model 1 and Model 2 are statistically significant. In case of Model 1, participation, network, population over 70 (%) and Row house & apartment unit in a house (%) are significant. The Adjusted  $R^2$  of model 1 is 0.656 and it is significant within 0.01 significant level. From the result of Model 1, we could find out that participation and network are negatively related to the dependent variable yet the percentage of row house & apartment unit in a house has positively relationship with dependent variables. It means that communities with high participation and network level are less likely to get damaged by typhoon and rainfall especially for casualties & victims. However, unexpectedly, the percentage of population over 70 years old is also negatively related to the dependent variable. For those aged 70 or older, they often live in social welfare facilities such as nursing homes. Living in such a welfare facility, it is relatively easy to evacuate in case of a disaster compared to the elderly living alone in a detached house, and it is relatively easy to get support during and after the evacuation. Thus, in order to control the effects of social welfare facilities on elderly people, social welfare facilities variables were included on Model 2.

When regression analysis of Model 2 was performed, including the social welfare facilities variables, we could confirm the percentage population of over 70-year-old was no longer significant, yet it was observed that social welfare facilities variable was significantly related to the dependent variable. And Adjusted  $R^2$  of Model 2 is 0.709, which is significant under 0.01 significant level. Only one variable among 11 independent variables – row house & apartment unit in a house (%) – has positive relationship with the dependent variable but other three independent variables – participation, network and social welfare facilities – are negatively related to the average number of casualties & victims (2008-2017). That's because row house & apartment unit in a house (%) are more likely to be flooded from meteorological disasters compared to the apartment or high-rise buildings. Also, some of them has a basement which are vulnerable to flood. Thus, that is positively related to the dependent variables.

## Conclusion

On both Model 1 and Model 2, it was observed that participation and network have negative relationship with the average number of casualties & victims. In the case of Model 1, the population over 70 years variable was the most influential in the dependent variable, while in Model 2 after adding social welfare facilities, the significance of the population over 70 disappeared. Further, standardized coefficients of other variables that were significant were slightly larger in Model 2. In conclusion, this analysis result implies that communities with high participation and network level, also having more social welfare facilities are less likely to get damaged from disasters. That is, high participation and network level are more likely to reduce the damage, especially for casualties and victims. Moreover, enough social welfare facilities could support elderly people, disable people or minorities and give initial aid during disaster occurrence or after recovery process.

This research can be meaningful in terms of examining the relationship between social capital and disaster damage. However, there are also few limitations. At first, social capital indicators were related to only the number of casualties & victims not property damage. In addition, according to the regression analysis, trust was not significantly related to dependent variable, yet it seemed to have positive relationship even though it was not statistically significant. Lastly, 'gu' as an analysis unit is quite large and extensive so it might be hard for this research to apply for much smaller district such as 'dong'. Thus, further research might be needed to address these limitations. To do so, availability of more specific data regarding disaster damage is needed and developing more social capital indicators which can measure property damage as well.

Even though there are few limitations, this research can be helpful for establishing important alternatives or policies in disaster management or disaster risk reduction. The active participation of the communities' members means that when a problem occurs, the issues required by the residents are properly reflected, and increased interest in the community can ultimately lead to a more desirable policy. In addition, those who build a strong relationship with others, or even weak ties can have the higher probability of receiving information or primary assistance in the event of a disaster. Therefore, social capital and its components should be considered as a critical method to reduce disaster damage in disaster risk reduction.

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