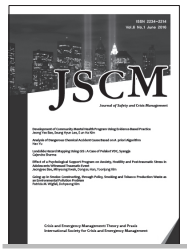

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Comparative Analysis of Public Officials‘ Perceptions and Vulnerability Assessment with Citizens' Perceptions of Climate Change: Focused on Danyang-gun

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A B S T R A C T

This study has intended to compare public officials' perceptions with citizens' ones of climate change and to compare climate change vulnerability assessment with citizens’ perceptions. To meet the goals, first, this study employed statistical analysis to analyze the differences in perceptions between the two stakeholders, and examined climate change sensitivity by health, disaster, forestry, water management, and ecosystem. Second, to compare climate change vulnerability with citizens’ perceptions, this study has adopted VESTAP, and a qualitative method. This study found the following results: 1) there were statistically significant differences in the perceptions between the two stakeholders in disaster and ecosystem area, and there were different areas of impact that differed by groups in health, disaster and forestry area; 2) In addition, there was a difference between vulnerability assessment results and citizens’ perceptions in forestry, water management, ecosystem area. Reducing the differences in perceptions between the two stakeholders can increase the effectiveness of implementing climate change adaptation policies. This study has proposed such policies as community system, and both education and promotion programs for citizens.

Key words: climate change, climate change adaptation policy, recognition survey, perception difference, vulnerability assessment, vestap, t test, multiple regression analysis

Introduction

Background and Purpose of Research

Since the Industrial Revolution, the impact on climate change has been growing due to the sustained over speed of global warming, and the damage to it has been increasing as well.

As a result, paradigm shifts are required to low-carbon economies, with international organizations such as the Intergovernmental Panel on Climate Change (IPCC). Abnormal weather conditions for climate change have been increasing in Korea, and the 「Comprehensive Framework Plan for Response to Climate Change」 was established in 2008 to cope with such international paradigm changes and abnormal climate conditions in Korea, and the 「Enforcement Decree of The Framework Act on Low Carbon, Green Growth」 took effect

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in 2010. Under the Enforcement Decree of The Framework Act on Low Carbon, Green Growth, detailed implementation plans for climate change adaptation were enacted and mandated for each region on a five-year basis, and policies for adaptation of climate change are established according to the local climate status and characteristics.

Currently, many local governments are conducting vulnerability assessments using VESTAP (Free Climate Change Vulnerability Assessment Support Tool Program) in developing policies for climate change adaptation. Vulnerabilities can be expressed as a function of three standards: sensitivity, exposure, and adaptability. Sensitivity indicates how much of an element of a climate-sensitive system is affected by climate change in situations where adaptation is not taken into account, and adaptability refers to changes in system operation caused by external stimuli such as climate change (Fussel, *et. al.,* 2006).

In the establishment of policies for adapting climate change to the basic self-regulated units, the present situation and analysis of climate change centered on local governments are mainly made up of a vertical structure. However, it is important to reflect the perceptions and opinions of local residents on climate change by surveying and in depth interview.

With the increasing awareness and importance of climate change and abnormal weather, research on this has been actively carried out in Korea. Kim, *et. al.*(2015) compared the climate status and outlook of the foundation and the vulnerability assessment results with the recognition of government officials and citizens, while Go, *et. al.*(2017) analyzed the perceptions of government officials and residents in Chungcheongbuk-do through a regression analysis. Yet studies on the perception of climate change among studies in Korea show that the opinions of residents and public officials are only compared or analyzed in a regression analysis. In addition, preceding paper comparing vulnerability assessment using VESTAP and citizens' perceptions of climate change is still lacking. Based on the literature review, this study has asked research questions as follows:

First, is there a difference between public officials' and citizens' perceptions of climate change?

Second, is there a difference vulnerability assessment results and detail sector of perceptions that citizens feel climate change the most?

Therefore, This study has intended to compare public officials' and citizens' perceptions of climate change, and to compare climate change vulnerability assessment and citizens' perceptions.

Study scope and composition

This study comprised the spatial scope of the study for eight townships and sections in Danyang-gun, and the time span was the survey collection period. The survey was conducted during October, 2018 by mail, and the survey on the recognition of the citizens was conducted by individual interview. The survey organized questionnaire into such 6 sectors as health, disaster, agriculture, forestry, water management and ecosystem areas, as was the case with the assessment of the vulnerability to climate change. The question consisted of a 5 Likert-type Scale. Agriculture area excluded the survey from the public officials' survey by professional expertise, and coast areas was excluded from the all surveys due to Danyang-gun's geographical features. Therefore, the agriculture area and coast areas were excluded from the scope of the study. The composition of this study consisted of introduction, literature review, research methodology, analysis of results, discussion and conclusion.

Literature Review

Literature Review

The paper on climate change has been actively being researched in Korea. The response to climate change can be largely distinguished by mitigation and adaptation, which is a policy to curb the cause of the outbreak by reducing greenhouse gas emissions, and adaptation is a policy to minimize the damage and impact that has already occurred or to adapt to the new climate by taking advantage of the new climate as an opportunity (GoJaejong, *et. al.,* 2010). In a survey, Kim, *et. al.*(2016) analyzed the determinants of the intention of climate change consciousness and response behavior through factor analysis, correlation analysis, and regression analysis.

In the development of this climate change policy, the citizens' perception of climate change, along with the a public official's perception of climate change, is very important. As a comparative analysis paper on public Official's and public perceptions, Kim, *et. al.*(2015) compared and analyzed the climate situation and outlook for Yeongwol-gun, vulnerability assessment using LCCGIS, and awareness among public officials and citizens. Jeong, *et. al.*(2015) compared and analyzed the general public aged 19 or older across the country and stakeholders related to adaptation. Go, *et. al.*(2017) compared the perceptions of public officials and citizens by analyzing the degree of influence of the detailed areas of each major area

through a categorical regression analysis, with the key areas as subordinate variables and the details as independent variables.

Differentiation of this study

To make this study differentiated from previous studies, this study has asked two research questions as follows: 1) to compare differences between public officials and the citizens on the perception of climate change; and, 2) to compare differences between vulnerability assessment results and citizens' perceptions using VESTAP. There were papers comparing differences between public officials and citizens in previous studies, but only simple comparative analysis and frequency analysis. In this study, the differences were analyzed through T tests and multiple regression analyses. We also compared and analyzed the vulnerability assessment results with VESTAP, which complemented the limitations of the existing LCCGIS.

As a result, it is possible to draw some implications to respond to the citizens' opinions when developing climate change adaptation policies and to establish policies that conform to regional characteristics.

Research Methods

Setting Study Hypotheses

This study used T-test and multiple regression analysis to compare and analyze the perceptions of public officials and citizens in Danyang-gun and compare them with VESTAP vulnerability assessment results.

There are studies that show significant differences in the perception of climate change between public officials and citizens as a result of the review of the preceding study, and studies that show differences between vulnerability assessment results and actual perception of climate change. Based on the research questions, the following hypotheses are established:

Hypothesis 1: There will be statistically significant differences between public officials' perception of climate change and the citizens' perception of climate change.

Hypothesis 1-1: The average of public officials' perceptions will be higher than the average of citizens' perceptions.

Hypothesis 1-2: Each will have a different detail sector that affects major area in the recognition of public officials and the citizens.

Hypothesis 2: There will be differences in vulnerability assessment results and detail sector of perceptions that citizens feel climate change the most.

Research Method and Data

Research Method

This study analyzed whether there were statistically significant differences in the average of public officials' and citizens' perceptions through the T test using the SPSS. Next, to analyze the detail sectors that affect the large area(health, disaster, water management, forestry, and ecosystem), detail sectors were set as independent variables, large area were set as dependent variables, and multiple regression analysis were performed using SPSS. In addition, we compared the differences between public officials and citizens in the detail sector that affect the large area.

Finally, the results of citizens' perceptions were averaged by detail sectors to draw out the detail sector that citizens felt the greatest climate change. We compared this with the VESTAP vulnerability assessment results to analyze the differences between the vulnerability assessment results and the citizens' perceptions using qualitative ways.

Data Requirement

The survey data used in this study were collected from eight towns in Danyang-gun on a frequent basis in October 2018. The vulnerability assessment data used climate data provided by VESTAP and collected and reprocessed data from eight towns in Danyang-gun.

Analysis and Synthesis

Descriptive Statistics

As shown in <Table 1>, gender ratio of the survey respondents was 54.5 percent for men and 45.5 percent for women for public officials, and 46.4 percent for men and 53.6 percent for women for citizens. For public officials, those in their 30s were the highest at 48.1 percent, while those in their teens and 60s were the highest at 25.1 percent for citizens. In the case of occupations, only citizens were surveyed and 26.2 percent of students were found to be the highest, apparently because elementary and secondary schools

<Table 1> Descriptive statistics

Category		Public Official		Citizen	
		Frequency	Ratio(%)	Frequency	Ratio(%)
Gender	Male	42	54.5	122	46.4
	Female	35	45.5	141	53.6
Age	10s	-	-	66	25.1
	20s	7	9.1	20	7.6
	30s	37	48.1	26	9.9
	40s	18	23.4	51	19.4
	50s	15	19.5	34	12.9
	over 60s	-	-	66	25.1
Occupation	agriculture/forestry	-	-	15	5.7
	Self-employment	-	-	27	10.3
	Public official	77	100	33	12.5
	Office job	-	-	39	14.8
	Technical profeesion	-	-	12	4.6
	Housewife	-	-	31	11.8
	Student	-	-	69	26.2
	etc.	-	-	37	14.1
Residential Area	Danyang-eup	54	70.1	105	39.9
	Mapo-eup	6	7.8	30	11.4
	Danseong-myeon	17	22.1	53	20.2
	Daegang-myeon	-	-	11	4.2
	Gagok-myeon	-	-	22	8.4
	Yeongchun-myeon	-	-	25	9.5
	Eosangcheon-myeon	-	-	6	2.3
	Jeokseong-myeon	-	-	11	4.2
Period of Residence	less than 2 years	13	16.9	21	8.0
	2-5years	16	20.8	22	8.4
	5-10 years	12	15.6	27	10.3
	10-15 years	10	13.0	44	16.7
	15-20 years	3	3.9	51	19.4
	more than 20 years	23	29.9	98	37.3

were put on the analysis list together. Danyang-eup was the highest with 70.1 percent for public officials, and Danyang-eup in citizens was the highest with 39.9 percent, but it appears to be evenly distributed in other areas compared to public officials. Government employees accounted for the largest portion of the residence with 29.9 percent, while citizens also had the largest share with 37.3 percent over 20 years.

<Table 1> shows the frequency and the effective ratio of the respondents' descriptive statistics.

T-test analysis results

T-test was carried out for comparative analysis of public officials' and citizens' perceptions of each area. The collective statistics showed that the average of public officials' perceptions in all areas is higher than that of citizens'. Although there were significant differences in the recognition mean in the ecosystem area, there were no significant differences in the recognition mean in health, water management and forestry areas. The following <Table 2> shows the collective statistics and T-test results.

Multiple regression analysis results

Health area

The results of the regression analysis showed that in the case of public official, the frustration of the respiratory system(HA02, T=2.661, p=0.01) affected the sensitivity, and the explanatory power

<Table 2> Population statistics and T test result

area	Occupation	Average	Standard deviation	T
Health	Public Official	2.44	0.769	0.327
	Citizen	2.32	0.972	
Disaster	Public Official	2.64	0.759	0.031*
	Citizen	2.39	0.905	
Water management	Public Official	2.68	0.751	0.219
	Citizen	2.54	1.032	
Ecosystem	Public Official	2.82	0.683	0.004**
	Citizen	2.53	0.932	
forestry	Public Official	2.88	0.707	0.063
	Citizen	2.70	0 968	

*p<0.05, **p<0.01, ***p<0.001

<Table 3> Results of health area sensitivity analysis

	Code	Unstandardized Coefficients		Standardized Coefficients	T	P
		β	SE			
Public official	HH01	0.177	0.122	0.169	1.451	0.152
	HH02	0.022	0.114	0.024	0.195	0.846
	HH03	0.161	0.119	0.164	1.354	0.180
	HC01	0.179	0.102	0.192	1.747	0.085
	HC02	-0.159	0.110	-0.184	-1.440	0.155
	HA01	0.024	0.138	0.023	0.175	0.861
	HA02	0.308	0.116	0.371	2.661	0.010**
	HI01	0.220	0.156	0.216	1.408	0.164
	HW01	-0.121	0.177	-0.106	-0.682	0.497
Citizen	HH01	0.153	0.077	0.123	1.973	0.050*
	HH02	0.012	0.057	0.012	0.209	0.835
	HH03	0.059	0.061	0.061	0.966	0.335
	HC01	-0.014	0.057	-0.014	-0.246	0.806
	HC02	0.123	0.051	0.143	2.419	0.016*
	HA01	0.063	0.065	0.059	0.967	0.334
	HA02	0.216	0.058	0.231	3.694	0.000***
	HI01	0.175	0.062	0.195	2.812	0.005**
	HW01	0.168	0.065	0.173	2.579	0.010**

*p<0.05, **p<0.01, ***p<0.001

of the model was very low at 2.55%. For the citizens, difficulties in outdoor activities due to the heat wave(HH01, T=1.973, p<0.05), the risk of heart system and cerebral blood system by cold wave(HC02, T=2.419, p<0.05), the frustration of the respiratory system(HA02, T=3.694, p<0.001), Infection by the medium(HI01, T=2.812, p<0.01), waterborne infectious disease(HW01, T=2.579, p<0.01) is shown to affect this sensitivity and the model has an explanatory power of 48.3%.

The following <Table 3>, show the results of the Health area Analysis.

Disaster area

The results of the regression analysis showed that in the case of public official, Increased frequency of gusts(MT01, T=2.146, p<0.05), Heavy snow(MS01, T=1.990 and p=0.05) is found to affect the sensitivity of the model with 49.5% explanatory power. In the case of citizens, Increase in property damage due to heavy rain and torrential rain(MF01, T=3.387, p=0.001), Increased frequency of gusts(MT01, T=2.154, p<0.05), Heavy snow(MS01, T=5.509, p<0.001) have been shown to affect the sensitivity and the model has a 46.9% explanatory power.

<Table 4> Results of disaster area sensitivity analysis

	Code	Unstandardized Coefficients		Standardized Coefficients	T	P
		β	SE			
Public official	MF01	0.164	0.134	0.178	1.222	0.226
	MF02	0.057	0.123	0.063	0.463	0.645
	MF03	0.132	0.138	0.147	0.956	0.342
	MT01	0.244	0.114	0.259	2.146	0.035*
	MS01	0.239	0.120	0.229	1.990	0.050*
citizen	MF01	0.202	0.060	0.236	3.387	0.001***
	MF02	0.060	0.072	0.066	0.835	0.405
	MF03	0.060	0.069	0.066	0.880	0.379
	MT01	0.128	0.059	0.150	2.154	0.032*
	MS01	0.284	0.051	0.322	5.509	0.000***

*p<0.05, **p<0.01, ***p<0.001

<Table 5> Results of forestry area sensitivity analysis

	Code	Unstandardized Coefficients		Standardized Coefficients	T	P
		β	SE			
Public official	FL01	0.131	0.149	0.132	0.877	0.383
	FL02	-0.038	0.154	-0.038	-0.245	0.807
	FF01	0.096	0.089	0.119	1.083	0.283
	FF02	0.114	0.170	0.111	0.672	0.504
	FF03	0.475	0.173	0.456	2.740	0.008*
citizen	FL01	0.121	0.049	0.125	2.459	0.015*
	FL02	0.115	0.051	0.121	2.250	0.025*
	FF01	0.010	0.040	0.011	0.252	0.801
	FF02	0.264	0.060	0.256	4.379	0.000***
	FF03	0.476	0.058	0.475	8.165	0.000***

*p<0.05, **p<0.01, ***p<0.001

Forestry area

The results of the regression analysis showed that in the case of public official, changes in forest production(FF03, T=2.7406, p<0.05) affect the sensitivity of the model, with 41.7% explanatory power. For citizens, the increase in landslide occurrence (FL01, T=2459, p<0.05), inconvenience in passage(FL02, T=2.250, p<0.05), change in forest plantation(FF02, T=4.37, p<0.001), and changes in forest production(FF03, T=8.165, p<0.001) were shown to affect the modality of the type and the model has a 71.6% explanatory power.

Water management area

The results of the regression analysis showed that in the case of public official, Increase in water shortage(WD01, T=3.891, p<0.001), and water degradation(WQ01, T=5.134 and p<0.001) affect the sensitivity of the model, with 51.0% explanatory power. For citizens, Increase in water shortage(WD01, T=6.021, p<0,001), and water degradation(WQ01, T=15.760, p<0.001) affect the sensitivity of the model, with 72.6% explanatory power.

Ecosystem area

The results of the regression analysis showed that in the case of public official, changes in plants(EP01, T=5.045, p<0.001) and changes in biological species(EA01, T=4.076, p<0.001) affect the sensitivity of the model, with 48.2% explanatory power. For citizens, changes in plants(EP01, T=8.351, p<0.001) and changes in biological species(EA01, T=18.353, p<0.001) affect the sensitivity of the model, with 75.3% explanatory power.

The following <Table 4>, <Table 5>, <Table 6>, and <Table 7> show the results of the disaster, forestry, water management, and ecosystem area Sensitivity Analysis.

<Table 6> Results of water management area sensitivity analysis

	Code	Unstandardized Coefficients		Standardized Coefficients	T	P
		β	SE			
Public official	WD01	0.318	0.082	0.359	3.891	0.000***
	WQ01	0.416	0.081	0.474	5.134	0.000***
citizen	WD01	0.250	0.042	0.255	6.021	0.000***
	WQ01	0.605	0.038	0.667	15.760	0.000***

*p<0.05, **p<0.01, ***p<0.001

<Table 7> Results of ecosystem area sensitivity analysis

	Code	Unstandardized Coefficients		Standardized Coefficients	T	P
		β	SE			
Public official	EP01	0.444	0.088	0.460	5.045	0.000***
	EA01	0.398	0.098	0.372	4.076	0.000***
citizen	EP01	0.316	0.038	0.304	8.351	0.000***
	EA01	0.665	0.036	0.668	18.353	0.000***

*p<0.05, **p<0.01, ***p<0.001

Comparative Analysis of Vulnerability Assessment and Citizens' Perceptions

The following <Table 8> shows the citizens' perceptions by scoring.

Health area

Vulnerability Assessment using VESTAP showed that the vulnerability to Warm-Heat Disease Vulnerability(for those aged 65 or older) was the most vulnerable, followed by increased ozone concentrations and vulnerability to Warm-Heat Disease Vulnerability (as of 2021-2030).

Results of citizens' perceptions show that difficulties in outdoor activities due to the heat wave(HH01), deterioration of air quality(HA01) are the highest sensitivity to climate change.

Disaster area

Vulnerability Assessment Using VESTAP shows that infrastructure for flooding is the most vulnerable (as of 2021-2030).

Results of citizens' perceptions show that heavy rain or heavy precipitation(MF02) is the highest sensitivity to climate change.

Forestry area

Vulnerability assessment using VESTAP showed that landslides caused by torrential rain were the most vulnerable, and that the larceny caused by landslides was the next most vulnerable as of 2021-2030.

<Table 8> Results of citizens' perceptions by scoring

Code	Score
HEALTH	2.68
HH01	3.34
HH02	2.93
HH03	2.68
HC01	2.81
HC02	1.91
HA01	3.01
HA02	2.66
HI01	2.13
HW01	1.89
DISASTER	2.61
MF01	2.51
MF02	2.68
MF03	2.50
MT01	2.41
MS01	2.21
FORESTRY	2.30
FL01	2.08
FL02	2.00
FF01	2.32
FF02	2.34
FF03	2.27
WATER	2.46
WD01	2.50
WQ01	2.46
ECOSYSTEM	2.47
EP01	2.62
EA01	2.30

Results of citizens' perceptions show that change in forest plantation(FF02) is the highest sensitivity to climate change.

Water management area

Vulnerability Assessment using VESTAP shows that vulnerabilities to water quality and aquatic life are the most vulnerable, and short-term drought (living water) is the next most vulnerable (as of 2021-2030).

Results of citizens' perceptions show that increase in water shortage(WD01) is the highest sensitivity to climate change.

Ecosystem area

Vulnerability Assessment using VESTAP shows that vulnerabilities to coniferous trees are most vulnerable (as of 2021-2030).

Perception analysis shows that both citizens and public officials, changes in plants(EP01) is the highest sensitivity to climate change.

Discussions and Policy Implications

The hypothesis 1 predicted that there would be statistically significant differences between the perception of public officials on climate change and the perception of the citizens, rejected some null hypothesis as there were statistically significant differences in disaster and ecosystem areas.

Hypothesis 1-1 was confirmed to be true because the average of public officials' perceptions in all areas is higher than citizens, which seems to be the result of why public officials have greater access to actual data and analysis data compared to citizens.

Hypothesis 1-2 was also found to be true in some areas, with other detail sectors affecting health, disaster and forestry areas. At this time, the detail sectors that affect the perception of citizens in all areas are commonly seen as related to real life, which is seen as a result of reflecting the perceptions of citizens who are related to real life.

Hypothesis 2 predicted that there will be differences in vulnerability assessment results and detail sector of perceptions that citizens feel climate change the most, which was confirmed to be true in forestry, water management, ecosystem area. However, there are more vulnerable detail sector of climate change for citizens than vulnerability assessment in health area.

The smaller the differences between public officials and citizens in their opinions and perceptions, the more appropriate policies can be established. Therefore, it is deemed necessary to form a community system that can narrow differences between citizens and public officials, to introduce a field survey and survey system for public officials before establishing policies, and to educate and promote citizens in policies related to climate change.

In addition, it is believed that the government should supplement establishing absolute policies centered on simple data-based assessment tools.

Conclusion

Therefore, This study has intended to compare public officials' and citizens' perceptions of climate change and to compare climate change vulnerability assessment and citizens' perceptions.

The results of the study confirmed that there were statistically significant differences in the perceptions of public officials and citizens of Danyang-gun in the areas of disaster and ecosystem. In addition, results of sensitivity analysis shows that public officials' result and citizens result have different detail sector affecting comprehensive perception in health, disaster and forestry area. Also differences existed between vulnerability assessment results and citizens' perceptions results in forestry, water management, ecosystem area. Therefore, it is deemed necessary to identify differences in vulnerability assessment and the perceived climate change among citizens and public officials and to focus on the opinions of citizens and practitioners in the course of developing measures to adapt to climate change and developing policies related to climate change.

The limits of this study are the lack of samples collected than the total population of Danyang-gun, where the characteristics of the arbitrary sample do not reflect the overall hierarchy and characteristics of Danyang-gun. In addition, there are limitations that could not be collected to reflect the characteristics of the population structure of Danyang-gun. Therefore, a more systematic and extensive institutional-level investigation is needed.

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