

Article

# A Study on the Perception of Carbon Neutrality to Overcome the Climate Crisis - Focusing on Chungcheongbuk-do -

Yeon Jun Kim\*

Ph.D. Candidate in Crisisonomy, Chungbuk National University, Chungbuk 28644, Korea  
[Ecofriends2050@naver.com](mailto:Ecofriends2050@naver.com); Tel.: +82-10-8639-1988

**Abstract:** Among the dangers posed by modern society, the climate crisis caused by excessive human greenhouse gas emissions is the most threatening to all mankind. The average annual temperature in Korea over the past 106 years (1912-2017) was 13.2°C, rising by about 0.18°C every 10 years. The resulting global economic loss has reached \$2.97 trillion over the past 10 years (2000-2019). Despite the serious risks and losses caused by the climate crisis, awareness and action are still insufficient overall. In addition, there have been few research papers on overcoming the climate crisis and realizing carbon neutrality in Chungcheongbuk-do, and it is difficult to establish a thorough carbon neutral action plan in Chungcheongbuk-do. Therefore, this study conducted a survey on 1,091 residents of Chungcheongbuk-do in Korea on their perception of the climate crisis to realize 2050 carbon neutrality. Based on this, we would like to provide basic data that suggests the direction of implementation of Chungcheongbuk-do's carbon neutral policy, such as reducing greenhouse gas in Chungcheongbuk-do and establishing a climate change response plan.

**Keywords:** Climate crisis, carbon neutrality, climate risk perception

## 1. Introduction

Thanks to the remarkable progress of human civilization and the rapid development of science and technology, modern individuals are leading more prosperous and abundant lives than ever before. However, beneath this prosperity, there exists an ironic reality where people live with various side effects and new risks, resulting in an anxious existence. German sociologist Ulrich Beck refers to this type of modern society as the "Risk Society," emphasizing that the advancements in science and technology, which humanity has accumulated, paradoxically expose humans to new risks, making "risk" a central phenomenon in society.

Recently, there has been an increasing use of terms such as "climate crisis" and "climate emergency" instead of "climate change." This is intended to express the associated risks more clearly (Park et al., 2021: 64; Yoon, 2022: 108). In particular, in the "Basic Act on Carbon Neutrality and Green Growth for Climate Crisis Response," the climate crisis is defined as a state where climate change causes irreparable risks to human civilization, such as water scarcity, food shortages, ocean acidification, sea-level rise, and ecosystem collapse, requiring significant greenhouse gas reductions.

With the global spread of irreversible climate crisis-related anxiety, countries around the world are making efforts to transition to a climate-safe society through carbon neutrality (Korea Environmental Institute, 2021: 27). As climate crisis phenomena are increasingly evident in our surroundings, it is now necessary to have a heightened awareness of new types of crises such as environmental and ecological crises and establish a meticulous management system for addressing them (Lee, 2018: 156). In fact, the average annual temperature in South Korea has increased by

approximately 0.18°C every decade, reaching 13.2°C over the past 106 years (1912-2017). Analyzing seasons, it is evident that the temperature rise is more pronounced in spring and winter, with increases of 0.24°C and 0.25°C, respectively (Ministry of Environment, 2020: 222).

Furthermore, compared to the past 30 years (1912-1941), the recent 30 years (1988-2017) have seen summers lengthen by approximately 19 days and winters shorten by approximately 18 days. The number of tropical nights in August has increased from approximately 1.8 days to approximately 6.2 days. The economic losses resulting from these changes were estimated to be around 4.4193 trillion won over the past decade (2011-2020). The global economic losses from weather-related disasters were estimated to be approximately \$2.97 trillion annually (Ministry of Environment, 2023: 18, 20). In the case of Chungcheongbuk-do province, the average temperature over the past decade (2011-2020) was 11.9°C, which is an increase of 0.6°C compared to the average temperature from 1981 to 2010 (11.3°C) (Korea National University of Education, 2022: 68).

This study aims to survey the residents of Chungcheongbuk-do province regarding their risk perception of the climate crisis, the roles of different actors, actual green lifestyle practices, awareness of carbon neutrality policies in Chungcheongbuk-do, and the general perception of policy performance. The goal is to provide foundational data for setting directions for Chungcheongbuk-do province to achieve carbon neutrality by 2050.

## 2. Theoretical discussion

### 2.1. Understanding carbon neutrality

South Korea, ranked 11th in global greenhouse gas emissions, has a vulnerable industrial structure in achieving carbon neutrality. The industrial structure is dominated by manufacturing and energy-intensive industries, with a focus on industries that emit large amounts of carbon, such as steel and petrochemicals. However, South Korea's greenhouse gas emissions have been gradually decreasing since reaching a peak in 2018. The emissions in million tons of CO<sub>2</sub>eq were 727.0 in 2018, 701.2 in 2019, and 656.2 in 2020, showing a decreasing trend for two consecutive years compared to 2018 (Ministry of Environment, 2023: 29). However, to achieve the 40% reduction target by 2030 under the Nationally Determined Contributions (NDC) and carbon neutrality by 2050, significant reductions in greenhouse gas emissions need to occur in the energy sector, which accounts for approximately 87% of the country's total emissions (Shin et al., 2022: 1-5). Achieving carbon neutrality is impossible without a drastic transformation in energy use (Korea Environmental Institute, 2021: 38).

To achieve carbon neutrality, it is essential to establish comprehensive laws and regulations since it is now a "necessity, not a choice." In this regard, South Korea enacted the "Basic Act on Carbon Neutrality and Green Growth for Climate Crisis Response" in 2021, providing a legal framework for carbon neutrality and specifying the duties of the national and local governments (Article 4). The law also emphasizes the active participation and cooperation of individuals, households, schools, businesses, and public institutions in practicing green lifestyles for carbon neutrality and collaborating with national and local governments' policies (Article 5).

### 2.2. Risk Perception

Risk can be defined as the potential for loss or harm that accompanies certain actions or phenomena (Rohrmann, 1997), and hazard refers to the potential material or immaterial substances that can cause physical, mental, economic, or environmental harm (Hohemser et al., 1986) (Lee, 2018: 8). In modern society, risk is highly subjective in terms of

perception. This means that individuals perceive risks differently based on their own perspectives, and attitudes and behaviors related to risk can vary.

Risk perception refers to individuals' subjective perceptions and attitudes toward objects that have the potential to cause material or psychological losses or damages in the future (Lee, 2020: 32). It plays a crucial role in promoting response behaviors to address the corresponding risks (Kim et al., 2018: 134). However, unlike expert-defined risks, the perception of risk by the general public is influenced by individuals' experiences and complex psychological and socio-cultural factors (Park et al., 2021: 64).

### 2.3. Citizen Practice

The current "Basic Act on Carbon Neutrality" stipulates the obligations of the national government, local governments (Article 4), public institutions, businesses, and citizens separately, in order to achieve carbon neutrality and green growth (Article 5). Specifically, citizens are encouraged to actively practice "green lifestyles" by conserving energy and resources and shifting to green products in their daily lives. They are also expected to participate in and cooperate with the policies of the national and local governments (Article 5, Paragraph 3).

In the case of Chungcheongbuk-do province, its industrial structure is characterized by high-carbon industries, such as cement production and manufacturing/construction, which account for 43.7% of the province's greenhouse gas emissions. In 2018, the direct emissions from the cement industry (8.39 million tons CO<sub>2</sub>eq, 31.4%) and manufacturing/construction (7.18 million tons CO<sub>2</sub>eq, 26.8%) amounted to 15.57 million tons CO<sub>2</sub>eq, which is 58.2% of the total emissions of 26.76 million tons CO<sub>2</sub>eq (Korea National University of Education, 2022: 103, 228). Considering this situation comprehensively, it is necessary to first conduct research on the overall awareness and behavioral practices of Chungcheongbuk-do residents regarding the climate crisis. Based on this, the direction of a Chungcheongbuk-do-specific carbon neutrality policy can be derived, and the momentum for implementation can be secured.

### 2.4. Policy Performance

Performance is a multidimensional concept and its definition is not easy as it can be understood differently depending on the characteristics and nature of individuals or organizations (Jeon et al., 2020: 84; Im et al., 2012: 6). However, government performance has been defined as "the degree and impact of fulfilling residents' needs and values realized through intentional government activities provided through public services" (Ra et al., 1999). In addition, performance in the public sector refers to "the extent of tasks, policies, and activities performed by organizations and their members for the production and provision of services" (Oh et al., 2011: 4). Although there is no unified criterion for assessing the success of various policies, there is a commonality that successful policies require high effectiveness in the policy process (Shim et al., 2018: 5). Furthermore, it is believed that policy users need to understand the content of the policy properly to enable efficient participation in the government's institutions and policy processes (Im, 2012: 4).

In this regard, to efficiently and swiftly cope with novel disasters such as the climate crisis or pandemics that pose threats to humanity as a whole, it is necessary to establish effective climate risk management policies by analyzing how various stakeholders, including the general public, perceive climate risks in diverse ways and what factors determine such perceptions. Based on this analysis, appropriate policy communication and participation methods can be devised (Lee et al., 2019: 2). General individuals, through various channels such as formal channels like elections and personal media that are increasingly developing, provide evaluations and judgments of policies based on their own perceptions. The value judgments of policies made by non-expert individuals like this

continually provide feedback throughout the policy formulation-decision-implementation-evaluation-feedback process and provide various information necessary for policy-related decision-making, making it a crucial factor (Im, 2012).

### 3. Research method

#### 3.1. Survey Design

In this study, a survey will be conducted to examine the following aspects: ① Perception of the climate crisis and risks, ② Role as an actor in addressing the climate crisis and achieving carbon neutrality, ③ Personal behavioral practices for addressing the climate crisis and achieving carbon neutrality, ④ Perception of carbon neutrality policies in Chungcheongbuk-do, and ⑤ Assessment of the performance and direction of carbon neutrality policies in Chungcheongbuk-do.

#### 3.2. Study Participants

To examine the level of risk perception among Chungcheongbuk-do residents regarding the climate crisis, the role of actors in achieving carbon neutrality, and the performance and direction of carbon neutrality policies in Chungcheongbuk-do, a survey was conducted with a total of 1,124 individuals aged 19 and above, residing in Chungcheongbuk-do. After excluding 33 participants with missing data in the age question, a total of 1,091 survey responses were used for the final analysis.

**Table 1.** Objectives and Survey Design

Sortation	Content
Subject of investigation	Men and women aged 19 or older living in Chungcheongbuk-do
a valid sample	1,091 viewers
Survey time	May 15-24, 2023
Survey Methods	Online Survey

#### 3.3. Questionnaire

The present study examined various aspects based on the classification of climate change indicators proposed by Kim et al. (2015) and referred to previous studies, including sociodemographic characteristics. The aspects investigated were as follows: ① perception of climate crisis and risks, ② role as an actor in addressing climate crisis and achieving carbon neutrality, ③ personal behavioral practices for addressing climate crisis and achieving carbon neutrality, ④ awareness of carbon neutrality policies in Chungbuk Province, and ⑤ evaluation of the achievements and future directions of carbon neutrality policies in Chungbuk Province (Kim et al., 2015; Park & Seo, 2021; Ministry of Culture, Sports and Tourism, 2020; National Communication Network Service, 2023; Jincheon County, 2019; Choi et al., 2020; Ministry of Environment, 2021).

#### 3.4. Analysis method

For this study, SPSS 26 was used to examine the sociodemographic background of the participants. Frequency analysis was conducted to determine the frequency and percentage distribution. To compare the actual conditions and perceptions regarding climate

crisis and carbon neutrality according to sociodemographic characteristics, cross-tabulation and chi-square tests were performed. To investigate whether there were differences in risk perception according to sociodemographic characteristics, t-tests, ANOVA, and Scheffe post hoc tests were conducted.

#### 4. Analysis Results

##### 4.1. Demographic and sociological background of study subjects

When examining the sociodemographic background of the study participants, the following findings were observed. Firstly, in terms of gender, there were 545 females (50.0%) and 546 males (50.0%). The age group with the highest proportion was the 50s. Regarding educational attainment, 770 participants (70.6%) had completed a 4-year college degree or higher, indicating a relatively high level of education among the study participants. In terms of total household income, the highest proportion was for incomes above 6 million won, while the lowest proportion was for incomes below 2 million won. In terms of occupation, the proportion of civil servants (including public sector employees) was relatively high compared to other occupations.

In terms of geographic distribution, there were 366 participants from Cheongju City (33.5%), 99 from Jecheon City (9.1%), 96 from Okcheon County (8.8%), 89 from Chungju City (8.2%), 80 from Yeongdong County (7.3%), 73 from Boeun County (6.7%), 69 from Danyang County (6.3%), 63 from Jincheon County (5.8%), 57 from Eumseong County (5.2%), and 46 from Gochang County (4.2%). Cheongju City had the highest proportion at 33.5%, proportionate to the actual population distribution of Chungbuk Province by city and county. Regarding employment type, there were 710 full-time employees (65.1%), 148 self-employed individuals (13.6%), 66 part-time employees (6.0%), and 59 unpaid family workers (5.4%). In terms of the number of children, there were 497 participants with 2 children (45.6%), 325 with no children (29.8%), 136 with 1 child (12.5%), and 133 with 3 or more children (12.2%).

##### 4.2. Differences in risk perception according to demographic background

The risk perception was examined based on the gender of the study participants, and there was a statistically significant difference. Next, the risk perception based on the age of the participants was not statistically significant. However, when examining the risk perception based on the educational attainment of the participants, there was a statistically significant difference, indicating that higher educational attainment was associated with a higher level of risk perception ( $F=15.113$ ,  $p<.001$ ).

Regarding the risk perception based on the geographic location, there was a statistically significant difference. The risk perception was higher in the Cheongju region (Cheongju City) and the central region (Jeungpyeong, Gochang, Jincheon, Eumseong) ( $F=3.418$ ,  $p<.05$ ). The risk perception based on the household income of the participants also showed a statistically significant difference. Similarly, the risk perception varied significantly based on occupation. The presence of disaster experience and climate crisis and carbon neutrality education also showed statistically significant differences in risk perception. Participants who had experienced disasters had a higher level of risk perception ( $t=2.448$ ,  $p<.05$ ), and those who had received education on climate crisis and carbon neutrality had a higher level of risk perception ( $t=6.984$ ,  $p<.001$ ).

##### 4.3. Perception and Practice

###### 4.3.1. Perception of the climate crisis

In the item "Do you actively search for information related to climate crisis?", the response rate for "Yes" was the highest at 34.4%. However, the combined percentage of "No" and "Not at all" responses was 24.1%, indicating a relatively low proportion of Chungbuk residents actively seeking information related to climate crisis. In the item "Can you explain the causes and impacts of climate crisis to others?", the combined percentage of "Yes" and "Very much" responses was 28.8%, while the combined percentage of "No" and "Not at all" responses was 29.1%. This indicates that the proportion of Chungbuk residents who cannot explain the causes and impacts of climate crisis to others is as high as the proportion of those who can explain. These findings suggest that there is room for improvement in terms of both actively seeking information related to climate crisis and being able to explain its causes and impacts among the residents of Chungbuk.

**Table 2.** Perception of the Climate Crisis (N=1,091)

Sortation	It's not like that at all	I don't think so.	be the normality	That's right.	It's very much so
Do you look for information about the climate crisis yourself?	41	222	348	375	105
	38	203	319	344	96
Can you explain to others what caused the climate crisis and its impact.	56	263	457	261	54
	51	241	419	239	49

When examining the item "In which sector do you think greenhouse gas emissions are the highest?", the following results were observed: 519 participants (47.6%) believed that the industrial sector (such as cement and manufacturing industries) emits the most greenhouse gases, 288 participants (26.4%) believed that the transportation sector (including cars, airplanes, and railways) emits the most, and 207 participants (19.0%) believed that the residential sector (including building heating and cooling, household waste) emits the most.

**Table 3.** What sector do you think emits the highest amount of greenhouse gases?

(N=1,091)

Sortation	N	%
Industrial sector (manufacturing, etc. such as cement) the entire	519	47.6
Transportation (automobiles, airplanes, railways, etc.)	288	26.4
Agricultural and livestock sectors (cultivation of rice paddies, livestock, etc.)	70	6.4
Living field (building heating and cooling, household waste, etc.)	207	19.0
Other	7	0.6
Total	1,091	100.0

When examining the item "In which sector do you think Chungcheongbuk-do should prioritize its efforts for greenhouse gas reduction?", the following results were observed: 504 participants (46.2%) believed that energy transition should be the priority, 247 participants (22.6%) believed that waste management should be the priority, and 198 participants (18.1%) believed that the industrial sector should be the priority for greenhouse gas reduction efforts.

**Table 4.** Which area should Chungcheongbuk-do make priority efforts to reduce greenhouse gas emissions? (N=1,091)

Sortation	N	%
Energy conversion	504	46.2
Transportation	60	5.5
Building	23	2.1
Waste matter	247	22.6
Agricultural livestock	56	5.1
Industry	198	18.1
Other	3	0.3
Total	1091	100.0

#### 4.3.2. Personal actions to overcome the climate crisis and achieve carbon neutrality

When examining the item "If it is necessary to participate in environmental education at least once a month to achieve carbon neutrality, do you have the intention to allocate your time to receive the education?" the following results were observed: 398 participants (36.5%) responded "Yes," 359 participants (32.9%) responded "Neutral," and 148 participants (13.6%) responded "No."

**Table 5.** Do you have the intention to allocate your time to participate in environmental education at least once a month to achieve carbon neutrality? (N=1,091)

Sortation	N	%
It's not like that at all.	63	5.8
I don't think so.	148	13.6
It's normal.	359	32.9
That's right.	398	36.5
It's very much so.	123	11.3
Total	1,091	100.0

#### 4. Perception of carbon neutral policies

Based on the question, "Are you familiar with the policies implemented in Chungbuk Province?" the following results were obtained: the highest number of respondents, 947

individuals (86.8%), were aware of the policy to avoid using disposable items; 938 individuals (86.0%) were familiar with the policy to reduce waste generation and practice proper waste separation and recycling; 936 individuals (85.8%) were knowledgeable about the policy to promote energy-saving habits; and 870 individuals (79.7%) were aware of the policy to reduce plastic usage and avoid excessive packaging in Chungbuk Province.

**Table 6.** Do you know about the policies implemented in Chungbuk Province? (N=1,091)

Sortation	Yes		No	
	N	%	N	%
Walking a short distance, riding a bicycle, and using public transportation	762	69.8	329	30.2
Reduce the use of plastic and avoid over-packaging	870	79.7	221	20.3
Reduce lifestyle habits of waste disposal and recycle waste well	938	86.0	153	14.0
Do not use disposable items	947	86.8	144	13.2
Active participation in environmental education programs related to the climate crisis and carbon neutrality	615	56.4	476	43.6
Actively practice after joining the carbon point system and automobile carbon point system	661	60.6	430	39.4
Making an Energy-Saving Life	936	85.8	155	14.2
Using eco-friendly products (such as low-nox boilers)	683	62.6	408	37.4
Stay away from meat, and adjust your diet to a vegetarian diet	439	40.2	652	59.8
Active participation in garbage picking, flogging, and carbon neutral campaigns	753	69.0	338	31.0

The expectations through the carbon neutrality policy, in response to the climate crisis, were ranked as follows: 700 individuals (64.2%) expressed the desire to safeguard safety from abnormal climate disasters and maintain sustainable lives, 201 individuals (18.4%) aimed to empower future generations to determine their own lives and protect their right to survival, and 124 individuals (11.4%) prioritized the harmonious coexistence of nature and humans by protecting other species.

**Table 7.** What do you expect through the carbon neutrality policy in response to the climate crisis? (N=1,091)

Sortation	N	%
Protecting safety from climate disasters and maintaining a sustainable life due to abnormal weather conditions	700	64.2
Harmonious coexistence of nature and humans by protecting other species	124	11.4
Letting future generations decide their own lives and protecting their right to live	201	18.4
Creating jobs with new growth opportunities	30	2.7

Protecting the economically disadvantaged and increasing social trust through a just transition	14	13
Resolution of generational conflict	3	03
Have nothing to look forward to	16	15
Other	3	03
Total	1,091	1000

## 5. Conclusion

In this study, a survey was conducted to investigate the perception of carbon neutrality among 1,091 residents living in 11 cities and counties in Chungbuk Province. Frequency analysis and difference tests based on demographic characteristics were performed using the SPSS program. The findings of this study are as follows. Firstly, there was a statistically significant difference in risk perception according to the gender of the participants, with females showing a higher level of risk perception ( $t=-3.513$ ,  $p<.001$ ). Secondly, when examining the reasons for perceiving low feasibility of adopting a low-carbon lifestyle, inconvenience and hassle (323 individuals, 29.6%) and the belief that individual actions would not have a significant impact (270 individuals, 24.7%) were the most common responses, highlighting the need for clear information on the current state of carbon neutrality practices. Thirdly, policies such as shifting towards a plant-based diet by reducing meat consumption (439 individuals, 40.2%) and actively participating in environmental education programs related to climate crisis and carbon neutrality (615 individuals, 56.4%) were found to have low awareness among Chungbuk residents, indicating a need for improved promotion efforts. Fourthly, when asked if they would tolerate a slight inconvenience in their daily lives for the sake of achieving carbon neutrality through strengthened laws and regulations, 73.4% of respondents answered "Yes" or "Strongly Yes." Fifthly, when examining how respondents became aware of Chungbuk Province's carbon neutrality policies, mass media (newspaper articles, news, etc.) was the primary source across all age groups, while the second-ranked source showed some variations depending on the age group. Sixthly, regional differences were observed in the adoption of climate crisis mitigation actions, indicating variations in behavioral practices across different areas within Chungbuk Province. Lastly, the perceived problems with Chungbuk Province's carbon neutrality policies included a lack of information regarding the scope and timing of climate change impacts (274 individuals, 25.1%) and inadequate support or institutional basis from the central government (176 individuals, 16.1%). The most effective measures to encourage participation in carbon neutrality policies according to respondents were raising awareness about the seriousness of the climate crisis and providing environmental education (272 individuals, 24.9%), social system support (270 individuals, 24.7%), and incentives or rewards (213 individuals, 19.5%). Overall, this study provides foundational data for Chungbuk Province to determine how to pursue and implement tailored policies, establish targeted promotion strategies, allocate specific roles to stakeholders, and identify areas that need improvement in their carbon neutrality efforts. It serves as a starting point for "Achieving Carbon Neutrality Together with Citizens" following Chungbuk Province's declaration of carbon neutrality in 2021, as part of the challenging process towards achieving the 40% reduction in NDC by 2030 and carbon neutrality by 2050. However, due to the limitations of a survey-based approach, this study could not delve deeply into the meaning behind each item, highlighting the need for further research.

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