Regional Response to Extreme Rainstorm Climate Disasters

- Centering on the Osong Underpass Disaster-

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Abstract

On July 15, 2023, when the Miho River embankment collapsed, the Osong Gungpyeong Underpass 2 was flooded, resulting in a disastrous accident in which 17 vehicles were submerged and 14 citizens lost their lives. Although no one intended it, it emerged as a representative case of climate disaster caused by extreme rain. Controversy over the fact-finding and accountability is still ongoing. The government and local governments have come up with various measures to prevent a recurrence, but it is unclear whether it will be effective. Climate disasters caused by extreme rain are expected to intensify in the future, and have become a fatal task for local communities to take on. It is necessary to examine whether a series of tasks such as identifying the cause and responsibility of the disaster, recovery at the scene of the accident and measures to prevent recurrence, support for victims and their families, healing and recovery, and preparing comprehensive disaster safety measures. The purpose of this study is to examine the process of response and action to the Osong Underpass disaster over the past year, and to find countermeasures at the local level to climate disasters caused by extreme rain.

Keywords: Osong Underground Road disaster, extreme rain, climate disaster, and community response measures

I. Introduction

The Osong Underpass disaster, which was highlighted as an example of an extreme climate disaster, marked its first anniversary. Fact-finding and accountability are still underway. The government and local governments are taking measures to prevent a recurrence, but controversy and conflict continue. The cause of climate disasters is global warming caused by an increase in greenhouse gases and the resulting extreme weather. Despite the launch of the new climate system in 2021, the 1.5°C increase in global average temperature proposed by the IPCC is expected to reach within just a few years. It is unclear how effective the national carbon-neutral green growth basic plan established to achieve 2050 carbon neutrality will be. The prospects for climate disasters are getting worse. Climate-related institutions and experts, including the World Meteorological Organization, are warning that the country may face the worst heat wave and heavy rain in 2024. One year after the Osong disaster, the community in Chungbuk cannot help but ask itself. Was the Gungpyeong 2 Underpass, which is preparing to open, safely taken? Has fundamental countermeasures been prepared for the flooding of the Miho River, which was a physical cause of the disaster? Has the emergency control system, which was the social cause of the disaster, been properly supplemented? Has a management system for the entire process of climate disasters such as prevention, preparation, response, and recovery been established? It is time for a comprehensive inspection. Climate disasters have emerged as the most serious and urgent complex disasters that threaten life and safety beyond the types and boundaries of disasters such as social disasters and natural disasters specified in the Framework Act on Disaster Safety. Through a comprehensive inspection and analysis of the Osong Underpass disaster, we intend to explore realistic countermeasures at the local community level to cope with the recurrence of climate disasters caused by such extreme rain.

II. Theoretical discussion

1. The climate crisis that has come to reality

Humanity is facing a climate crisis. Since 2020, we have experienced a pandemic caused by COVID-19, and we are falling into a situation of destructive climate disasters such as heat waves, heavy rains, droughts, and wildfires. Hawaii wildfires and Libya's major floods occurred in 2023 alone, and Chungbuk had to suffer froman overflow of Goesan Dam and a Osong underground road disaster due to the collapse of the Miho River embankment. As such, the climate change problem is intensifying in the form of a climate crisis and a climate disaster.

A series of crisis situations are related in combination. The climate problem caused a change in the ecosystem, which created the basic conditions for the spread of infectious diseases. Although the fossil fuel-based capitalist economic and social structure has had a direct impact on causing the climate crisis, the actual reduction of greenhouse gases to overcome the climate crisis is possible only when it deviates from the economic and social structure of development and growth. As such, humanity is facing a complex crisis, and the most serious and central problem among them is the climate crisis.

Since industrialization, humans have been using fossil fuels excessively, and the concentration of greenhouse gases in the atmosphere exceeded 400 ppm as of 2015. In a special report, the IPCC emphasized that the global average temperature increased by 1.09□ compared to before industrialization, and that the temperature increase should be controlled to within 1.5□. To this end, it also suggested the goal of achieving 2050 carbon neutrality. In order to overcome the climate crisis, a new climate system was launched in 2021 in which 195 countries participated in greenhouse gas reduction. Governments in each country, including Korea, have raised their greenhouse gas reduction targets, and 133 countries declared carbon neutrality at the end of 2022. The international community is seeking a major shift to a decarbonized economic and social structure by accelerating energy conversion and green new deal policies.

Nevertheless, the time to reach the 1.5°C increase in the average global temperature, which can be called the tipping point, is rapidly accelerating. The 6th report of the 2022 IPCC predicted around 2030. According to the World Meteorological Organization (WMO) announcement in June 2024, although this may be a temporary phenomenon, the range of temperature increases in 2023 exceeded 1.45°C, and 1.63°C increased for one year from June 2023 to May 2024. It is predicted that there is an 80% probability of a year that has increased by 1.5°C or more within the next five years.

2. a climate disaster that threatens daily life

Climate disasters are threatening our daily lives and the survival of humanity. Heatwaves, heavy rains, severe colds, wildfires and droughts are due to the effects of climate change caused by global warming. Summer heatwaves are caused by global warming that weakens the jet stream and stagnates the high pressures formed in the mid-latitude region, preventing hot air from escaping. In the same vein, in winter, cold air flows in the polar regions push down the weakened jet stream, causing cold weather.

The Australian bushfires, which began in September 2019, were the worst major wildfires that lasted for six months until February 2020. Already, the combination of extreme weather such as heat waves, drought, and strong winds has caused untouchable fires. The forest fires have destroyed 18 million hectares of land, which is larger than the size of Korea, and are estimated to have sacrificed 1.25 billion wild animals. Australia is the world's largest exporter of coal and one of the highest carbon emissions per capita, and wildfires have emitted an additional 400 million tons of carbon dioxide.

The COVID-19 infection broke out in Wuhan, China, at the end of December 2019 and spread widely. The World Health Organization (WHO) declared a pandemic in March 2020. As of July 2023, the total number of confirmed cases was 748 million, and the death toll exceeded 6.9 million. It is analyzed that the causes of the zoonotic infection are due to animal contact, dense residential environment, environmental destruction and ecosystem disturbance, and especially climate change. According to a report by the University of Cambridge in 2021, as climate change changed

the vegetation of southern China and adjacent regions, 40 new species of bats have flowed in over the past 100 years, and the possibility of new viruses has increased.

It was also found that the abnormal high temperature phenomenon was the biggest factor in the Siberian forest fires that began in May 2020. The temperature in the first half of the year in Siberia was higher than 5□ on average compared to other years, and in June, it was higher than 10□. The temperature on June 20 in Verkhoyansk, known as the coldest region in Russia, recorded 38□. It was confirmed that the abnormal high temperature phenomenon in the Arctic Circle affected the heavy rain in Asia.

In the summer of 2020, East Asia faced the worst floods. The nation continued to have an all-time rainy season for more than 54 days. Four typhoons made landfall in succession, and torrential rain with an hourly rainfall of 80 to 90 mm fell, causing landslides, flooding, and flooding across the country. 7,000 people were displaced, and the number of casualties was 46, and property damage was KRW 1.258.5 trillion, which is more than three times the average over the past decade (2010-2019). During the same period, China was even worse. Floods in the southern part of the country continued for two months, with more than 50 million people killed and property damage of more than KRW 24 trillion. Heavy rains continued for about a month in Japan, resulting in more than 80 deaths.

In August 2022, torrential rains of more than 100 mm per hour (maximum 141.5 mm) and 400 mm per day occurred in Seoul and the metropolitan area. The super typhoon Hinnamno led to the Pohang underground parking lot disaster. In July 2023, the Miho River and Nonsancheon Stream embankments were lost due to extremely heavy rain that could have fallen once in 500 years in the central region. Osong Underpasses caused by the collapse of the Miho River embankment were also the cause of the disaster. Prior to this, Cheongju-si in 2017 continued to experience severe drought throughout the first half of the year, before torrential downpours of 90 mm per hour and 300 mm per hour for three hours on July 16. Cheongju-si and the central region of North Chungcheong-do, which were considered safe zones, were swept away by floods.

Climate disasters have come as a threat to our daily lives. David Wallace-Wells (2020), the author of The Uninhabitable Earth, gave a stark description of the 12 threats of climate disasters that global warming can cause. The 12 factors collectively refer to deadly heat waves, poverty and hunger, engulfing seas, soaring wildfires, disasters that have become weather, thirst and drought, carcasses, non-drinking air, the spread of disease, a collapsing economy, a climate dispute, and the collapse of systems. However, what is happening now is nothing more than a harbinger of climate disasters to come.

III. Current Status and Problems of Osong Underpass Disaster

1. Overview of Osong Underpass Disaster

In the three days since July 13, 2023, more than 500mm of heavy rain poured down in the Cheongju area. On July 15, at around 8:40 am, a temporary embankment near the Mihocheon Bridge collapsed, flooding the Mihogang River, and flooding of 60,000 tons of water flooded the nearby Gungpyeong Underpass in Osong-eup. Seventeen vehicles were submerged in the underground roadway, and 14 people were killed and 16 injured.

At least one of the four stages of disaster management, such as prevention, preparation, and response, did not work properly. After the disaster, work and controversy surrounding the identification of the cause and responsibility began in earnest. The biggest causes of the disaster are concentrated in two ways. Failure to control traffic and the collapse of the embankment of the Miho River. The causes of the Osong Underpass disaster are a combination of social and physical causes. It is obvious that systematic responses and preemptive measures should have been taken in a situation where the risk of flooding is high due to the issuance of a flood warning. Currently, the inspection and investigation are in full swing. The possibility of applying the Serious Disaster Punishment Act is also being considered.

It suffered damage from torrential rain in 2017, but six years later, it faced a bigger disaster in 2023. If it rains more than 30mm for an hour or more than 80mm per day, it is called torrential rain. Extreme rain is the case of more than

50mm for an hour, more than 90mm for 3 hours, or more than 72mm for an hour. The Cheongju area is already in the midst of climate disasters caused by extreme rain. In a situation where precipitation patterns are changing due to climate change, disasters and disasters can occur at any time unless fundamental measures are taken.

The inspection and investigation of traffic control failures, which were noted as social causes, were launched immediately after the disaster, and the cause and responsibility are currently being identified through trials. The fact that local environmental groups and the Miho River Basin Council focused their attention immediately after the disaster was the reason for the collapse of the Miho River Embankment, which can be said to be a physical cause. Since we were aware of the need to prepare measures for repeated floods and disasters, we proposed a joint investigation team to investigate the cause of the collapse of the Miho River Embankment on July 19, 2023.

2. Response and actions after the disaster

2.1. Identification of the cause and responsibility of the disaster

After the disaster, the investigation and other responsibilities began in earnest. The Cheongju District Prosecutor's Office has indicted a total of 30 people and two corporations, including the Happy City Construction Office, the Geumgang River Basin Environmental Office, the police, the fire department, the temporary relief contractor and the supervisor team of the Miho River, and handed them over to trial by holding them responsible for the Osong Underpass disaster. Recently, investigations are continuing on local government officials such as Chungcheongbuk-do and Cheongju.

On December 22nd and 28th, 2023, the prosecution arrested and charged the head of the construction site and the head of the supervision team of the Mihocheon Bridge expansion construction. In the first trial ruling on May 31st, 2024, thecourt sentenced the field director to 7 years and 6 months in prison and the head of the supervision team to 6 years in prison on charges of professional negligence and forgery of evidence. The court ruled that the application for permission to occupy and use the river was part of the construction company's work, and if the embankment cut was inevitable, a separate permission should have been obtained. It was judged to be a serious negligence close to intention and was sentenced to the highest court sentence.

Through the trial, it was confirmed that the direct cause of the disaster was a temporary embankment that had been poorly built. According to the River Act, a permit for river occupancy and use must be submitted to the Geumgang River Basin Environmental Office, but the contents on the existing embankment, temporary embankment construction, and restoration to the original state were not included. It did not obtain permission from related agencies and did not comply with the regulations. The temporary embankment, built from June 29, 2023, did not meet the standards. According to the river embankment construction standard specification, the height of the embankment should be 1.5m higher than the planned flood level. The planned flood level for the Mihocheon Bridge area was 29.02m, and the height of the existing embankment was 32.65m, which was sufficient. The last changed design in April 2023 stated that it was 30.04m, but the actual temporary embankment height was 29.74m. The design was wrong and the construction was sloppy. In preparation for the rainy season, soil was only started to be overlaid on June 29, and pledge work was rarely done. It was confirmed that it was not covered with tarpaulin.

Three officials from the Geumgang River Basin Environmental Office were also put on trial. After granting permission to occupy and use rivers for the expansion of the Mihocheon Bridge, they were charged with not checking whether the construction company fulfilled the conditions or conducting an on-site inspection. They said that even though they knew that the existing embankment was demolished and temporary embankment was built, they did not order restoration to its original state.

Another direct cause was the failure to control the underground roadway on the day of the disaster in a timely manner. On May 9, 2024, the Cheongju District Court held its first trial on 14 police officials, including the former chief of the North Chungcheong Provincial Police Agency, who were indicted on charges of professional negligence resulting in

death and preparation of false official documents. Immediately before the accident, emergency evacuation and underground roadblocks were also poorly dealt with 112 reports requesting emergency control, and were suspected of making false documents such as work logs after the accident. However, they denied the charges at the trial.

Controversy over whether or not the emergency rescue control team was operated and when it was operated are also being revealed. The Cheongju Seobu Fire Station reported to the National Assembly that it preemptively operated the control team, issuing the first stage of response from 6:30 a.m., two hours before the disaster. A false official document was prepared, and the timing of operation was reversed to around 10:04 after the disaster. Two executives, including the head of the Cheongju Seobu Fire Station, are being prosecuted without detention for preparing false official documents and are on trial. At the first trial on June 12, 2024, he admitted to the charge of making a false report on the response to the disaster site.

The application of the Serious Disaster Punishment Act has also emerged as an important issue. Although two years have passed since the Serious Disaster Punishment Act was implemented. No cases have yet been handed over to trial as a serious civil disaster. The road was not controlled even though there were several reports and contacts on the risk of flooding and flooding of the Miho River. Cheongju City was found to have received 10 emergency calls, the Happiness Administration 7 times, and Chungcheongbuk-do 3 times. Chungcheongbuk-do, the management body of the Gungpyeong 2 Underpass, failed to take timely traffic control measures.

Heads of institutions sued for violating the Serious Accident Punishment Act were summoned one after another. The head of the Administrative-Centered Complex City Construction Administration was summoned by the prosecution on March 14, 2024, and the mayor of Cheongju on April 26. On May 1, the governor of North Chungcheong Province was questioned for 16 hours. However, the outlook is mixed as to the extent to which the scope of comprehensive responsibility for the chief executive officer will be recognized. The law stipulates that business owners or managers must organize manpower and budget necessary for disaster prevention, implement corrective and improvement orders from central administrative agencies, and take management measures in accordance with safety and health-related laws.

The investigation is expected to be completed in June as the summons investigation on the head of the local government has been completed. However, it is expected that it may be delayed as the prosecution's investigation command is replaced. The prosecution recently indicted 10 more public officials in North Chungcheong Province and Cheongju City. Attention is focusing on whether the indictment of the head of the local government will continue.

2.2. Measures to recover accident site and prevent recurrence

Due to the delay in field investigation and budgeting, field restoration work began in April 2024, nine months after the accident occurred. Ahead of the first anniversary of the disaster, the government and local governments are rushing to prepare measures to prevent a recurrence.

North Chungcheong Province said it will reopen the Gungpyeong 2 Underpass from the end of June 2024. Since the accident, a 4-kilometer section of the road including a 430-meter section of the underpass has been closed. Vehicle access blocking facilities and road electronic boards have been installed. When the water level in the underpass exceeds 15 centimeters, the blocking facility automatically operates. The electronic board will display the level of the Mihocheon Bridge, allowing the user to check the status of the flood. Restoration of the underground road surface, replacement of drainage pumps, installation of emergency stairs, handrails and water cutoff walls are underway. In response, the civic committee for the Osong disaster, the bereaved families' council and the survivors' council criticized it as "clearing traces of the disaster," arguing that investigation into the cause and measures to prevent the disaster should come first.

As the project has been postponed, the river maintenance project in the outer reaches of the Miho River, which provided the root cause of the collapse of the Miho River embankment, is also being carried out in earnest. A new

embankment of 1.68 kilometers up and down the Miho River is under construction. If the width of the embankment is widened from 350 meters to 610 meters, the possibility of river flooding may decrease. The temporary embankment will be dismantled when the new embankment is completed. The problem is the construction period. North Chungcheong Province said it would complete the construction early in June before the rainy season, but the Geumgang River Basin Environment Agency, the implementation site, said the construction period will be until September 2025.

On June 11, 2024, North Chungcheong Province reiterated its plan to prepare for flood damage and provided a supplementary explanation for concerns over poor construction of the Miho River embankment. The construction of the embankment consists of six processes, and the first phase of the embankment is expected to be completed by the end of June. However, since the existing embankment is maintained, there is no problem in preparing for torrential rain. Dredging of the riverbed will also be carried out. The government plans to invest 1 billion won to take emergency measures around the Miho River, and to spend 11.6 billion won to overhaul all 5.5 kilometers of the Miho River in the long run.

2.3. Support, healing and recovery for victims and their families

Right after the disaster, North Chungcheong Province had conflicts with the bereaved families over the duration and location of the memorial altar for the victims. With the first anniversary of the disaster just around the corner, the provincial government wanted to push ahead with such projects as setting up a memorial and producing a white paper. However, the Chungcheongbuk-do Provincial Council cut all of its budget of 120 million won (10,800 U.S. dollars), saying, "In order to honor the souls of the victims, finding the truth must come first." It also took issue with the fact that opinions of the bereaved families and survivors were not reflected.

On May 7, 2024, the Lawyers for a Democratic Society, the Osong Disaster Citizens' Countermeasures Committee, and the Headquarters of the Campaign to Create a World Without Major Disaster urged the prosecution to prosecute the governor of North Chungcheong Province and the mayor of Cheongju. It said that holding the government accountable is the start of establishing a system that fundamentally prevents disasters and disasters. Chungcheongbuk-do is the main body of maintenance and repair of the Miho River embankment, and the governor of Chungcheongbuk-do failed to manage the Miho River embankment and the second underground roadway in Gungpyeong, which are public facilities, under the Serious Disaster Punishment Act. In addition, the mayor of Cheongju claimed that he did not properly perform his authority and responsibility for emergency measures in the event of a disaster or a disaster.

On May 8, 2024, victims of the Sewol, Itaewon, and Osong disasters claimed at a "policy proposal debate for the protection of the rights of victims of disasters and disasters" that victims should guarantee their rights to participate independently in the process of coping with, coping with, and supporting disasters in the 5th National Safety Management Basic Plan (2025-2029). The National Safety Management Basic Plan is the top-level plan that sets the basic direction of national disaster safety management. The Ministry of Public Administration and Security plans to submit the final draft to the Central Safety Management Committee in June 2024. The contents of support for victims include "operating an integrated support center in case of large-scale disasters" and "providing one-stop support services for victims and their families." Experts said that in the support system designed for administrative convenience, victims did not receive the necessary support in time and were excluded from the process of recovery and investigation and their right to know was violated, suggesting that the victim-centered approach be reflected in the basic plan. He pointed out that laws, systems and practices should be reformed so that victims can participate as subjects in the entire process of rescue, evacuation, search for missing persons, fact-finding, memorial projects, and system improvement.

On June 5, 2024, the Osong Underpass Disaster Survivors' Association held a press conference in front of the Ministry of Public Administration and Security in Sejong City, urging the government to find out the truth and come

up with measures to prevent a recurrence through an investigation into the cause of the disaster. The National Disaster Cause Investigation Council, which was launched last year, pointed out that it is avoiding the investigation of the cause of the disaster.

2.4. Formulating comprehensive disaster safety measures

① Chungcheongbuk-do Provin

On May 27, 2024, Chungcheongbuk-do announced a strategy to strengthen disaster safety management. Since the accident occurred, the 'Safety Chungbuk 2030 Project' in which all real countries participate has been promoted to review the existing disaster safety management system from the origin, to prepare fundamental, mid- and long-term improvement measures such as system improvement and reinforcement measures, and discovery of safety culture diffusion projects. Based on the results, three strategies and 33 implementation tasks were set: strengthening the safety system, spreading safety culture, and enhancing safety expertise.

As a prevention-oriented safety system reinforcement and reorganization strategy, it plans to carry out projects to prevent pre-emptive accidents through thorough safety inspections, strengthen safety management of underground roads, change the disaster response system centered on the site, prepare fundamental measurement measures for the Miho River, and strengthen the water capacity of Goesan Hydro Dam and Dalcheon. A total investigation and special inspection of 411 areas where human damage is feared, and a joint public-private safety inspection of 1,300 facilities vulnerable to safety will be conducted.

In the first half of the year, the installation of automatic blocking facilities at 30 underground lanes is completed, and a four-person system is implemented to promote meticulous preliminary forecasting. In particular, a water barrier installation project with a maximum height of 4.3m and a straight extension of 520.7m will be promoted in the Osong Gungpyeong 2 underground road. Strengthen the disaster response capabilities of public officials through crisis management manual maintenance and disaster countermeasure headquarters mission training. An AI-based 119 report reception system that converts the caller's call into text will be established, and 436 additional fire vehicle video transmission systems will be installed.

As a project to measure the Miho River to prevent river flooding and flooding accidents, the sedimentary section of the Miho River High-speed Railway Bridge and the 6km section of Seokhwacheon Stream will be dredged first before the rainy season, and the new river maintenance project will be completed by June. In the long run, the government plans to raise the design frequency of the basic river plan and propose large-scale dredging of the Miho River's Osong section to the Ministry of Environment. Goesan Dam and Dalcheon, which are at risk of overflow and frequent flooding in case of torrential rain, will improve the level of dam operation during flood season and weather warning, and install reservoirs in the upstream area of Goesan Dam to prevent overflow and flooding accidents.

As a strategy to spread safety culture to enhance awareness of the safety culture of the residents, natural disaster accident insurance will be established in the provincial safety insurance to expand the coverage that was limited to the dead to the injured. The government will regularly promote the public-private joint safety inspection campaign, the Residents' Safety Project, and continue to promote projects to raise awareness of the safety of the residents and spread safety culture by conducting safety culture education for the vulnerable. As a strategy to improve sustainable safety expertise in the future, a mid- to long-term disaster response system will be established by promoting research services for Chungbuk Disaster Safety Vision 2030 and integrated disaster safety control projects. The government plans to strengthen the expertise of local safety institutions and disaster safety management by promoting the establishment of the Chungbuk Safety Foundation, which will complement the limited role of administrative agencies, and strengthening the research function of the Disaster Safety Research Center.

In addition, through a prospective review of the system to improve treatment, such as personnel preference and allowance support for public officials in the disaster safety department, support measures will be prepared so that

competent and outstanding public officials can work at the disaster safety department for a long time to enhance their expertise.

② Government

According to the data of the "2024 Ministry of Environment-Local Governments Meeting on Flood Response" presided over by the Ministry of Environment on April 29, 2024, a total of 132 defects were found in major river facilities and construction sites. In some cases, major embankments were cut off or drainage gates essential for water level control did not work. The Ministry of Environment has decided to reinforce all facilities before the flood season.

The ministry plans to use artificial intelligence (AI) to prevent flood damage. From May, the number of flood forecasting points using AI technology has been increased from 75 to 223. At those points, AI automatically predicts floods in the event of torrential rain and issues an alarm. Monitoring of river water levels will be carried out in a total of 673 locations every minute. The "urban flood forecast," which was first implemented in Dorimcheon in Seoul in 2023, has been expanded to include Hwangryong River in Gwangju, Naengcheon River in Pohang, and Changwon Stream. From July, navigation automatically guides safe routes for flood-prone areas. When a driver enters a location near a point where a flood warning is issued or a dam is released, the driver automatically informs the driver that it is a dangerous area. The plan is to take another route that does not pass through underground roads or low-lying areas to prevent the second Osong disaster. The safety guide text message has also been changed to provide information on user areas and surrounding areas of concern over flooding by utilizing location information on mobile phones.

On May 16, 2024, the Ministry of Public Administration and Security announced the government-wide "Comprehensive Measures for Natural Disasters in Summer 2024" at a meeting of related ministers. The government will operate a five-month countermeasure period from May 15 to prepare for the summer storm and flood. Under a situation where record-breaking weather phenomena are frequently observed, the government plans to make all-out efforts to minimize casualties in summer. In the case of storm and flood damage such as heavy rain and typhoons, the government will focus on managing the three types of human damage such as landslides, river disasters, and flooding in underground spaces, and will focus on measures such as on-site responses, protection of vulnerable groups, and support for damage recovery. In particular, landslide prediction information will be managed by subdividing it from the current second stage of "warning and warning" to the third stage of "warning and additional preliminary warning and warning." It is also noteworthy that the number of flood warning points based on artificial intelligence, which used to be the center of national rivers, has increased from 75 to 223, including local rivers. If a vehicle enters near the point, it plans to guide the danger through navigation.

In order to prevent the recurrence of accidents such as the "Osong Underground Road Disaster," 256 additional underground roadway entry blocking facilities will be installed, with a total of 508. For underground roads that are feared to be flooded, four people in charge of the site, consisting of two public officials, one police officer and one civilian, will be designated to strengthen control and management of the site, and new standards for controlling underground roads, which were different for each local government, will be unified to 15cm in depth of flooding.

IV. Measures to Respond to Extreme Rainfall Climate Disasters in the Community

1. Follow-up Measures for Osong Underpass Disaster

Several clear follow-up measures and improvement measures are needed in community resources to prevent a recurrence of climate disasters such as the Osong Underpass disaster.

1.1. Severe measures against illegal demolition and damage of river banks

As we have seen, the direct cause of the Osong Underpass disaster is the illegal demolition of the existing embankment and the poorly established temporary embankment. It can be said that the primary responsibility is to the

administrative-centered complex city construction agency, which is the implementer of the Mihocheon Bridge expansion project, the construction company and the supervisor who illegally demolished the embankment and took poor measures, as well as the Geumgang Basin Environment Agency, which failed to perform the responsibility of management supervision even after recognizing the act of damaging the embankment. As investigations and trials are currently underway, severe measures must be taken.

1.2. Revolutionary changes in emergency response systems to cope with emergency disaster situations

Even if the collapse of the embankment was the direct cause, the disaster could have been prevented if it had responded urgently to the emergency situation. Although a flood warning was already issued early in the morning of the day and there were numerous reports and reports, no one took swift action. Even if physical supplementary devices such as access blocking facilities, road signboards and water cutoff walls, artificial intelligence (AI) and digital forecasting systems are installed, safety cannot be guaranteed if people-centered social response systems such as recognition of emergencies, cooperation, and on-site response are not operated. A cooperative system that includes not only related organizations but also on-site residents should be established, and sufficient training courses should be carried out at the same time.

1.3. Completion of river maintenance projects in the riverside area quickly and preparation for special preparation until completion

The original project period of the river maintenance project in the outer reaches of the river, which was established to solve the bottleneck near the Mihocheon Bridge, was from March 2017 to December 2021. Despite the flood damage in July 2017, the project was suspended in 2020 due to the bridge expansion. After the disaster, the construction resumed, but the first phase of the bank building was completed by the end of June, and the entire construction is expected to be completed only in September 2025. A soil embankment has been stacked behind the soil embankment. The problem is that in the case of the newly established Mihocheon Bridge, the altitude under the top of the bridge is 30.28m, which is lower than the existing embankment of 31.45m. The highest flood level was 29.87m, but if a larger flood occurs, there is a possibility of similar flood damage. This is why special countermeasures must be prepared.

1.4. Strengthen design standards for the Miho River and completely supplement the basic river plan

The design criteria for the basic river plan should be strengthened in consideration of the flood amount of more than 100 years to the flood amount of 200 years or more. Among the national river sections, the frequency of 200 years is applied to the section downstream of the combined monthly river section, but the section upstream of the monthly river is applied at a frequency of 100 years. The design standards for the Miho River, where two fatal floods have occurred in the last 6 years, should be strengthened to the level of the mainstream of the Geumgang River. Reflecting these contents, the basic river plan, which can be the standard for river management, should be re-established. When establishing a basic river plan, the principles and directions of watershed management should be established, and social consensus should be reached. In consideration of the water supply, dimensions, and environmental functions in a balanced manner, it is necessary to ensure that the watershed management is safe from disasters, and that is pleasant and ecologically healthy for citizens. In particular, it is desirable to introduce nature-based solutions that consider the river environment rather than a uniform method centered on dredging.

2. Measures for Community Response to Extreme Rainfall Climate Disaster

1.1. Share awareness and spread of the seriousness of climate disasters caused by extreme rains

Cheongju area has long been recognized as a city unrelated to flood damage. In 2017, heavy rain of 91.8 mm per

hour rained about 300 mm for 3 hours. In the three days before and after the Osong disaster in 2023, extreme heavy rain of 500 mm or more fell. In a situation where extreme heavy rains become frequent, there can be no more safe zone. The World Meteorological Organization is warning that the global Eligno phenomenon could accompany extreme heat waves and heavy rains in 2024. Above all, sharing and spreading awareness of climate disasters should precede. Public relations and education on climate disasters should be strengthened, and administrative efforts and support should be expanded.

1.2. Strengthen the legal system for disasters and safety, establish a participatory plan, and prepare a cooperative implementation plan

The Framework Act on Disaster and Safety defines a disaster as one that can damage the lives, bodies, property, and the state of the people, and categorizes it into social and natural disasters. Climate disasters that have recently emerged are frequent and fatal in terms of causes and phenomena, but there is no special consideration for such complex disasters.

According to the Framework Act on Disaster and Safety, a national safety management plan (province safety management plan) should be established and a central safety management committee (province safety management committee) should be formed. The Ministry of Public Administration and Security has established the 4th National Safety Management Basic Plan, and as of 2024, the 5th National Safety Management Basic Plan (2025-2029). However, it is operating very loosely compared to other legal plans. It is necessary to improve and strengthen related legal systems. In particular, the regional financial safety plan should go beyond the level of policy plan and become a more systematic comprehensive plan (measures). Participatory plans should be established in which all walks of life combine and cooperative implementation plans should be prepared.

1.3. Establishment of a participatory disaster management system and information platform suitable for the climate disaster era

A disaster management system suitable for the era of climate disasters should be established. The disaster management system should be comprehensively reorganized to enable prevention and preparation based on the participation of residents and rapid and preemptive response and recovery centered on the site. Attempts to involve the private sector in disaster management for underground vehicles are desirable. However, more routine and continuous participation plans need to be prepared. Recently, the Miho River Basin Center and the Residents River Management Team, which are Miho River Basin Governance Organizations, were launched to establish an integrated participatory cooperation-type watershed management system. It is necessary to add disaster prevention projects to the category of integrated river management projects and strengthen resident participation-type disaster management activities by supplementing the Miho River Integrated Management Support Ordinance. The participatory river disaster prevention function could also be included in the Miho River Comprehensive Information Platform promoted by Chungcheongbuk-do.

1.4. Establishment and operation of an environmental safety foundation to strengthen community resilience

Immediately after the Osong disaster, North Chungcheong Province sought various measures and measures for disaster safety after consulting related experts. What stood out was the establishment of the Disaster Safety Foundation. On the first anniversary of the disaster, North Chungcheong Province reiterated the importance of establishing a disaster safety foundation. The Chungbuk Green Transition Forum and environmental organizations recently proposed to establish an environmental safety foundation that can respond to environmental and disaster problems in an integrated manner, as the nature of disasters facing local communities has the nature of climate disasters. The foundation can function in the dimension of prevention, preparation, and recovery from disasters. It is possible to

strengthen the disaster resilience and response capabilities of local communities through various activities such as education promotion to improve awareness, training for emergency response, participation and resource activities in the recovery process, memorial service for victims, healing and recovery, evaluation analysis, and policy improvement measures.

V. Conclusion

It has been one year since the Osong Underpass disaster occurred. We looked at the response and measures after the last year's disaster. Focusing on related news, key contents and issues were analyzed on the identification of the cause and responsibility of the disaster, whether the Serious Disaster Punishment Act was applied, measures to recover and prevent accident sites, support for victims and their families, and preparation of comprehensive disaster safety measures.

However, related trials are still underway, North Chungcheong Province is rushing to reopen underground roads at the end of June, and the Osong disaster bereaved family council and the civic group strongly call for a thorough fact-finding mission and punishment for differences of responsibility. One year has passed since the disaster, but controversy and conflict have not been resolved. Experts and related agencies are raising the possibility of the worst heat wave and heavy rain in summer 2024. There is a high possibility that the country will face extreme downpours beyond those of 2017 and 2013. Several clear follow-up measures and improvement measures are needed from community resources to prevent climate disasters such as the Osong underground road disaster from happening again.

As a follow-up countermeasure against the Osong Underpass disaster, first, severe action against illegal demolition and damage of river banks is required. Second, a drastic change in the emergency response system is needed to cope with an emergency disaster situation. Third, the river maintenance project in the out-of-river zone should be completed quickly, but special countermeasures should be prepared before completion. Fourth, the design criteria for the Miho River should be strengthened and the basic river plan should be completely supplemented. As a countermeasure for climate disasters caused by extreme rain by local communities, first, it is necessary to share and spread awareness of the seriousness of climate disasters caused by extreme rain. Second, the legal system for disaster and safety should be strengthened, and participatory plans should be established and cooperative implementation plans should be prepared. Third, it is necessary to establish a participatory disaster management system and information platform suitable for the era of climate disasters. Fourth, it is necessary to establish and operate an environmental safety foundation to strengthen the resilience of local communities.

If the past year has been the process of dealing with the accident and finding out the responsibility for the Osong Underpass disaster, now it should be turned into a time of blessing in disguise, seeking fundamental reflection, recovery, and ultimate alternatives at the community level. I hope this study will be the beginning of the evaluation and discussion of climate disasters caused by extreme rain.

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