



Mapping the Risk and Effect of Radioactive Contamination of Groundwater Sources from the Punggye-ri Nuclear Test Site in North Korea

Special Report, February 2023



TRANSITIONAL
JUSTICE
WORKING GROUP

**MAPPING THE RISK AND EFFECT OF RADIOACTIVE
CONTAMINATION OF GROUNDWATER SOURCES
FROM THE PUNGGYE-RI NUCLEAR
TEST SITE IN NORTH KOREA**

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About TJWG

The Transitional Justice Working Group (TJWG) is a human rights documentation NGO established in Seoul in 2014 by human rights activists and researchers from five countries (South Korea, North Korea, the United States, the United Kingdom and Canada). We aim to develop the best practice to address mass human rights violations and to realize victim-centered approach and justice in societies that are making a transition from or have yet to make a transition from armed conflict or dictatorship. We cooperate and share experience with organizations and individuals who take lead in human rights documentation and accountability for mass atrocities.

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INTRODUCTION

There have been calls in the past to highlight the linkage between the North Korean nuclear and human rights issues. In January 2013, Navi Pillay, then-UN High Commissioner for Human Rights, expressed her concern that “at the international level, the spotlight is almost exclusively focused on DPRK’s nuclear programme and rocket launches” and added that “while these, of course, are issues of enormous importance, they should not be allowed to overshadow the deplorable human rights situation in DPRK, which in one way or another affects almost the entire population and has no parallel anywhere else in the world” as she called for a full-fledged international inquiry into serious crimes that had been taking place in North Korea.¹

The 2014 Report of the UN Commission of Inquiry on Human Rights in the Democratic People’s Republic of Korea stated that:

“The State has consistently failed in its obligation to use the maximum of its available resources to feed those who are hungry. Military spending – predominantly on hardware and the development of weapons systems and the nuclear programme – has always been prioritized, even during periods of mass starvation.”²

Since then, resolutions and statements by other countries or international organizations on the human rights situation in North Korea also point out the deterioration of the human rights situation as a result of the North Korean

¹ Office of the United Nations High Commissioner for Human Rights, “Pillay urges more attention to human rights abuses in North Korea, calls for international inquiry”, January 14, 2013, <https://www.ohchr.org/en/press-releases/2013/01/pillay-urges-more-attention-human-rights-abuses-north-korea-calls?LangID=E&NewsID=12923>.

² United Nations Human Rights Council, Report of the Commission of Inquiry on Human Rights in the Democratic People’s Republic of Korea, A/HRC/25/63, February 7, 2014, ¶ 51, <https://undocs.org/A/HRC/25/63>.

government investing scarce resources in nuclear and weapons development. Accordingly, there is a growing international awareness that resolving the nuclear issue is inextricably linked to human rights issues.

North Korea's rulers have sought to maximize international interest in its nuclear capabilities while avoiding attention on its human rights issues. There is in fact a tendency to view the North Korean nuclear issue solely from a security perspective. Governments and research institutes around the world have been focusing on monitoring and analyzing the type, scale, evidence and signs of resumption of nuclear tests. By contrast, there has been little interest in human rights violations such as forcible transfer of population, forced labor for nuclear tests and threats to human security caused by soil or water resource contamination. A few media outlets reported stories of North Korean escapees who had lived near the nuclear test site, but interest did not last.

Six nuclear tests have made Punggye-ri and Mt. Mantap internationally famous, but there has been a dearth of studies on how many people live near the site of repeated tests of increasing magnitude, what they eat and drink and how their health is affected. Nevertheless, mapping the possible range of leakage and dissemination of radioactive materials through groundwater points to a large area and population at risk.

The populations in neighboring countries such as South Korea, China and Japan are also exposed to the radioactive risk from the contaminated agricultural and marine products imported from North Korea. It is the responsibility of the respective governments to find out and inform the public about where North Korea's nationally advertised specialties like "Mt. Chilbo pine mushrooms" are grown and how they are consumed across borders.

South Korea is the country best suited to conduct a meaningful epidemiological investigation provided it has the political will, since there are nearly 900 North Korean escapees who had lived in the areas near the Punggye-ri nuclear test site after the first nuclear test in 2006. But South Korea's Ministry of Unification reluctantly conducted radiation exposure tests for only 30 escapees in 2017 and 10 escapees in 2018 and covered up the test results showing worrying levels of chromosomal abnormalities among 9 of them (22.5 percent); the tests ceased from 2019. The South Korean government under President Moon Jae-in (2017-2022) avoided publicizing issues expected to rattle North Korea.

Since 2019, TJWG has been gauging the interests of diplomats and journalists at home and abroad. The diplomats expressed interest and pointed out that, despite the need to discuss the North Korean nuclear issue along with the North Korean human rights issue, it has been difficult to find concrete links thus far. The journalists stated that there are limits to reporting based on rumors or interviews with a few North Korean escapees.

TJWG continued to collect information and data while waiting for an opportune moment. From March 2022, the news of impending resumption of nuclear tests brought about a renewed interest.³ With the end of Seoul's appeasement of North Korea following the inauguration of the Yoon Seok-yeol government in May 2022, an environment conducive to the disclosure of relevant information emerged. Therefore, TJWG decided to gather and organize

³ "N. Korea carrying out construction at Punggye-ri nuclear test site: sources", *Yonhap News Agency*, March 27, 2022, <https://en.yna.co.kr/view/AEN20220327001200325>; Peter Makowski, Jack Liu, and Olli Heinonen, "Punggye-ri Nuclear Test Site: New Activity at the Command Center Area", *38 North*, May 5, 2022, <https://www.38north.org/2022/05/punggye-ri-nuclear-test-site-new-activity-at-the-command-center-area/>.

information to publish a visual report explaining the issue in a coherent manner.

The purpose of this report is fivefold. First, it sets out to clarify the indivisibility of the North Korean nuclear issue and the North Korean human rights issue. Second, it aims to inform the North Korean people about the risk of harm caused by repeated nuclear tests through various means and channels. Third, there is a need to raise awareness about the health risks posed to the people living in South Korea, China and Japan, due to the smuggling and distribution of agricultural and marine products from North Korea. Fourth, the report aims to persuade the South Korean government to expand the radiation exposure tests for the North Korean escapees who had lived in the areas near the Punggye-ri nuclear test site and to disclose the test results. Fifth, TJWG urges the interested states and international organizations to discuss what to explore and how to proceed with additional investigations based on the contents of this report.

MAIN FINDINGS AND RECOMMENDATIONS

Hundreds of thousands of people living in the areas near the Punggye-ri nuclear test site are at risk from the leakage and dissemination by water of the radioactive materials from the nuclear test site.

- There are 8 cities and counties (Kilju County, Hwadae County, Kimchaek City, Myonggan County, Myongchon County, Orang County, Tanchon City and Paegam County) of 3 provinces (North Hamgyong Province, South Hamgyong Province and Ryanggang Province) by administrative division within a 40km radius of the nuclear test site or within the scope of influence from the Mt. Mantap-Changhung Stream-Namdae Stream water system.
- According to North Korea's 2008 census data, the total population of the eight cities and counties is approximately 1.08 million.
- It is not known whether the prisoners at Kwanliso (political prison camp) No. 16 adjacent to the nuclear test site were included in the census of Myonggan County (formerly Hwasong County). The number of prisoners is known to be approximately 28,700 (as of June 2022).
- Out of approximately 1.08 million people, the affected population would be approximately 540,000 or 270,000 under the assumption that 50 or 25 percent respectively has been affected.
- Considering the number of deaths over the 17 years since the start of the nuclear tests in 2006, the affected population may be higher.
- The actual situation of water use is of particular concern. North Korea's 2008 census data shows that nearly one out of every six households (15.5%) in North Hamgyong Province which includes Kilju County uses groundwater, waterhole, public tap, spring, etc. as drinking water. Since the chronic shortage of electricity makes the piped water into dwelling units useless, it appears that more households are in fact using groundwater, waterhole, etc. as drinking water.

As a result of the smuggling and distribution of agricultural and marine products and local specialties like pine mushrooms from the areas near the Punggye-ri nuclear test site, not only the North Korean people but also the populations in neighboring countries such as South Korea, China and Japan may also be at risk.

- Despite the risk of radioactive contamination through water, agricultural and marine products from the areas around Punggye-ri are consumed mainly by local people while the local specialties like pine mushrooms are distributed to other regions and overseas as a highly profitable and secret way to earn foreign currency for the North Korean government.
- Pine mushrooms grow not only around Mt. Chilbo but also in mountains within a 40km radius of the Punggye-ri nuclear test site. North Korean escapees from Kilju County and Paegam County stated that the locals picked pine mushrooms from the Mt. Chilbo area prior to the construction of the nuclear test site and that the picking of mushrooms has continued in the mountains around the restricted area after its construction.
- In 2017, China's Ministry of Environmental Protection and the Central Military Commission of the Chinese Communist Party (CCP) reacted with alarm at a possible radioactive leakage after North Korea's 6th nuclear test; however, the Chinese authorities have failed to stop the smuggling of North Korea's agricultural and marine products or their distribution within China or to a third country.
- In 2015, the South Korean authorities detected 981Bq/kg or more than 9 times the standard level of radioactive cesium isotopes (Cs-134 and Cs-137), which is 100Bq/kg, in dried hedgehog mushrooms imported from North Korea disguised as Chinese products but were not able to identify the area of origin within North Korea. In 2018, the South Korean government came under criticism for giving away the pine mushrooms that President Moon Jae-in had received as a gift from Chairman Kim Jong-un to about 4,000

elderly separated families reportedly without radiation testing.

- Although Japan banned all imports from North Korea after North Korea's first nuclear test in 2006, North Korean pine mushrooms disguised as Chinese products in "pine mushroom laundering" are in demand because their price is 1/10 that of the Japanese ones. The Japanese authorities have arrested and prosecuted the executives of the pro-Pyongyang General Association of Korean Residents in Japan (Chongryon) involved in the smuggling operations and reportedly obtained transaction documents between Chongryon and Office No. 39 of the Workers' Party of Korea (WPK) in North Korea, responsible for raising slush funds for North Korea's supreme rulers, stating that the export of pine mushrooms is a state project. There was no news about the testing of the mushrooms for radioactive contamination.

After reluctantly initiating radiation exposure tests, South Korea's Ministry of Unification watered down the test results revealing abnormalities in 9 out of 40 North Korean escapees from the areas near the Punggye-ri nuclear test site (22.5 percent) in 2017 and 2018 and ceased the tests from 2019; testing all 160 escapees who had lived in Kilju or all 881 escapees who had lived in the areas near the Punggye-ri nuclear test site since North Korea's 1st nuclear test in 2006 can be done with a budget of about 250 million won (211,000 USD) or 1.4 billion won (1,164,000 USD) respectively.

- The pioneering research by North Korean escapee Dr. Choi Kyong-Hui, president of SAND Institute, and her efforts to publicize the issue as well as concerns about radioactive leakage after North Korea's 6th nuclear test made the Ministry of Unification initiate its own radiation exposure tests for the escapees.
- The Ministry of Unification presented the results of the radiation exposure

tests conducted on 30 North Korean escapees from Kilju County in 2017 in an informal oral briefing restricted to the South Korean media journalists and downplayed the significance of the test results. The Ministry of Unification reduced the number of test subjects in 2018 to 10 people and failed to announce the test results for 9 months after the completion of testing until the issue was raised at the National Assembly.

- Among the 30 escapees tested in 2017, 4 (13 percent) showed 7 to 10 stable chromosomal abnormalities and the median radiation dose was 279 to 394 mSv while among the 10 escapees tested in 2018, 5 (50 percent) showed 7 to 59 stable chromosomal abnormalities and the median radiation reached 279 to 1,386 mSv.
- Those who stayed in Kilju County until the 3rd to 6th nuclear tests period tend to have more chromosomal abnormalities and higher radiation doses than those who stayed until the 1st and 2nd nuclear tests period. There was one test subject who had escaped from Myongchon County, but none from Kilju County, immediately after the 6th nuclear test. Therefore, the South Korean government needs to actively contact the North Korean escapees who have experienced the 3rd to 6th nuclear tests period and expand the number of test subjects.
- The National Assembly recommended the Ministry of Unification and the Korea Institute of Radiological & Medical Sciences (KIRAMS) to conduct tests for all North Korean escapees from the areas near the nuclear test site, but the two organs ceased the testing from 2019 and it has yet to resume as of February 2023.
- Among a total of 33,882 North Korean escapees who have entered South Korea by the end of 2022, those who had lived in Kilju County and the areas near Punggye-ri after North Korea's 1st nuclear test in 2006 are 160 and 881 respectively; those who had lived in Kilju County and the areas

near Punggye-ri after the 6th nuclear test in September 2017 are 3 and 20 respectively (as of February 2022).

- According to the unit price of 1,568,000 KRW (1,300 USD) per person for the radiation exposure tests applied by the Korea Institute of Radiological & Medical Sciences (KIRAMS) in 2017-2018, it would take 253,760,000 KRW (211,000 USD) to test all 160 escapees who had lived in Kilju County after 2006 and 1,397,266,000 KRW (1,164,000 USD) to test all 881 escapees from the areas near the Punggye-ri nuclear test site.

TJWG, mindful of the seriousness and transboundary nature of the risk of nuclear leakage and contamination, recommends the following to governments, international organizations and other stakeholders:

- The North Korean government: a complete, verifiable, and irreversible denuclearization (CVID); a prompt, effective, thorough, independent and impartial investigation and disclosure of its findings; notification of the risk and other protective measures for the people in the 8 cities and counties near the Punggye-ri nuclear test site, testing of agricultural and marine products.
- The South Korean government: the disclosure of the full reports for the radiation exposure tests conducted in 2017 and 2018; notification of the risk for the North Korean escapees who had lived in the 8 cities and counties near the Punggye-ri nuclear test site after 2006 and resumption of tests; strengthened inspection of agricultural and marine products from North Korea; and the insertion of the risk of Punggye-ri's radioactive contamination in statements and resolutions concerning North Korea's nuclear development and human rights situation.
- The Chinese government: the disclosure of past radioactive environment survey results; strengthened inspection of agricultural and marine products

from North Korea; and the insertion of the risk of Punggye-ri's radioactive contamination in statements and resolutions concerning North Korea's nuclear development and human rights situation.

- The Japanese government: strengthened inspection of agricultural and marine products from North Korea; and the insertion of the risk of Punggye-ri's radioactive contamination in statements and resolutions concerning North Korea's nuclear development and human rights situation.
- Other governments and regional bodies: the insertion of the risk of Punggye-ri's radioactive contamination in statements and resolutions concerning North Korea's nuclear development and human rights situation; and publicization by governments, human rights ambassadors, human rights reports as well as parliamentary resolutions and reports.
- UN: inclusion of the risk of Punggye-ri's radioactive contamination in the North Korean security and human rights agenda at the UN Security Council, General Assembly and Human Rights Council; and publicization through the UN special procedures mandate holders, North Korea's 4th cycle Universal Periodic Review (UPR) in October/November 2024 and the monitoring committees of core human rights treaties to which North Korea is a party.
- IAEA: call for North Korea's investigation of the risk of radioactive leakage and contamination from the Punggye-ri nuclear test site based on the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency which North Korea signed in 1986.
- Civil society, media, and ordinary citizens: call for a prompt, effective, thorough, independent and impartial investigation and urge the governments and international organizations to take the measures stated above.

INFORMATION COLLECTION

From the results of the radiation exposure tests conducted on 40 North Korean escapees by the Korea Institute of Radiological & Medical Sciences (KIRAMS), TJWG identified a summary of the information for 9 test subjects (anonymized) with chromosomal abnormalities from the records of the National Assembly Foreign Affairs and Unification Committee's inspection of state administration for the Ministry of Unification in 2019.

TJWG collected relevant records from the minutes of the National Assembly proceedings from 2000 to 2022 using the National Assembly Information System database.⁴ TJWG looked into the minutes and appendices of relevant standing committees (the Foreign Affairs and Unification Committee; the Science, ICT, Broadcasting and Communications Committee; Agriculture, Food, Rural Affairs, Oceans and Fisheries Committee; Health and Welfare Committee; Environment and Labor Committee; and the National Policy Committee) and the Special Committee on Budget and Accounts as well as their subcommittees. It was possible to find out the answers given by the heads of government ministries, including the Ministry of Unification, and of related organizations such as the Korea Institute of Radiological Medical Sciences and Nuclear Safety and Security Commission.

TJWG also collected press releases and clarification materials from the various government organs including the Presidential Office, the Ministry of Unification and the Ministry of Food and Drug Safety. Staffers at the offices of members of the National Assembly provided assistance in tracking the follow-up measures of the government organs after the issues raised or changes demanded at the National Assembly. They also helped ascertain the status of the North Korean

4 국회정보시스템 [The National Assembly information system], <https://likms.assembly.go.kr/>.

escapees from the eight cities and counties near the nuclear test site including Kilju County.

North Korea's spatial materials including "The Geographical Compendium of North Korea" published by North Korea's Educational Books Press as secret materials in 1990 and "The Encyclopedia of North Korean Geography and Culture" published jointly by North and South Korea in 2003 also served as sources of information.

TJWG's database created from interviewing about 800 North Korean escapees from 2015 to 2022 offered locational and contextual information that appear to have relevance from the statements given by 32 people who had lived in the areas near the Punggye-ri nuclear test site. In the additional interviews with 4 North Korean escapees, TJWG asked them about their awareness and perception of the nuclear tests, drinking water sources, pine mushroom distribution and picking methods, acquisition of marine products from in nearby seas and methods for sales of agricultural and marine products to other areas while in North Korea. They were also asked about their experience participating in and their opinions about the radiation exposure tests conducted by the Korea Institute of Radiological & Medical Sciences (KIRAMS) at the Ministry of Unification's request.

THE RISK OF LEAKAGE AND DISSEMINATION OF RADIOACTIVE MATERIALS THROUGH WATER

The Punggye-ri nuclear test site and concerns about groundwater contamination

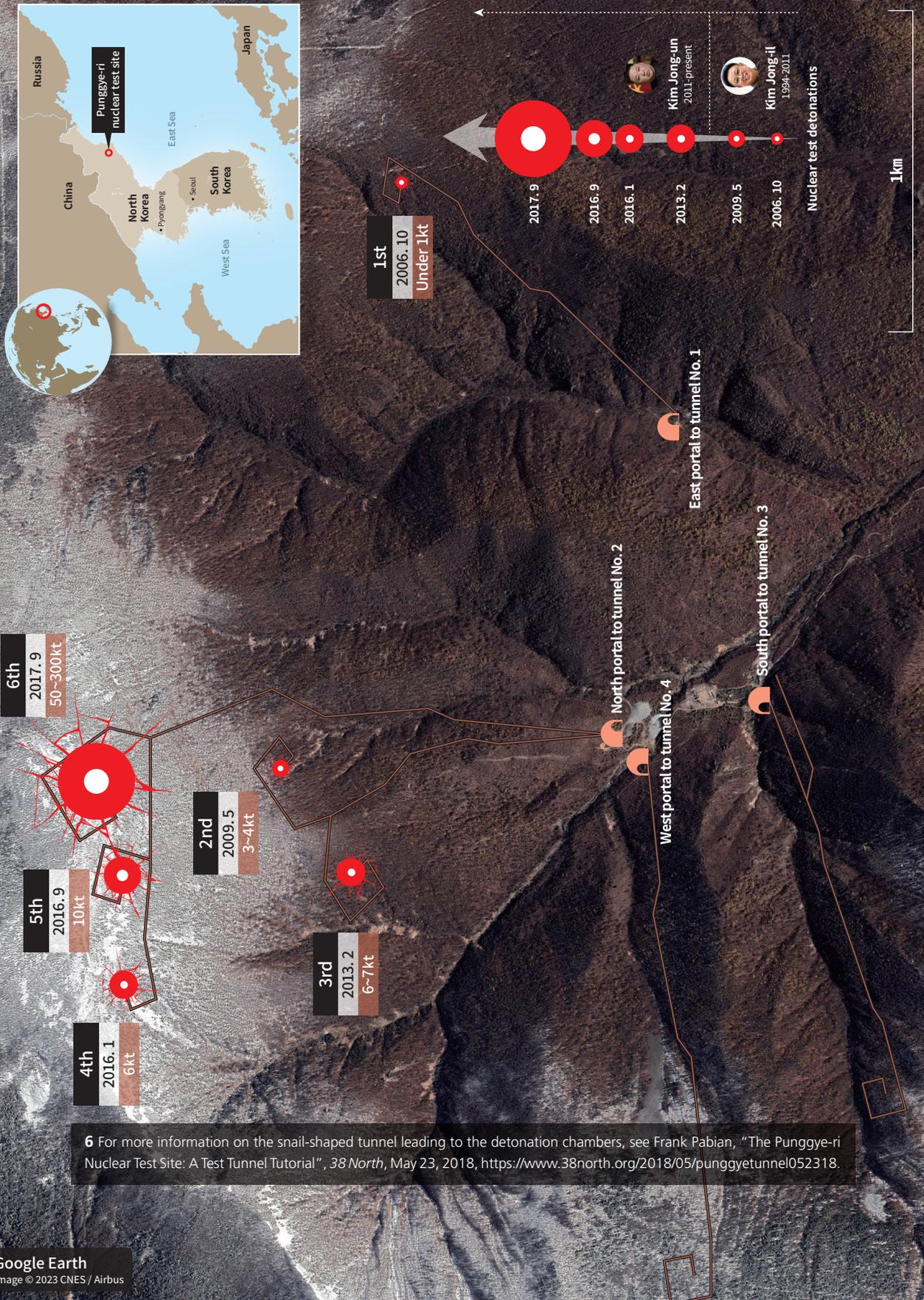
North Korea's nuclear test site, which has been called the "Punggye-ri Nuclear Test Site" or "Kilju Nuclear Test Site", is located on Mt. Mantap in Punggye-ri, Kilju County, North Hamgyong Province. The official name used by North Korea is the "Northern Nuclear Test Site". North Korea conducted six nuclear tests here from 2006 to 2017. The 1st and 2nd nuclear tests were conducted during Kim Jong-il's rule while the 3rd to 6th nuclear tests were conducted during Kim Jong-un's rule after Kim Jong-il's death in December 2011. The most powerful nuclear test was the 6th nuclear test in September 2017.

There are reportedly many detonation chambers inside the nuclear test site along the portals of the four tunnels running north, south, east and west. Other than the 1st nuclear test in 2006 that was conducted in the detonation chamber inside the portal to tunnel no. 1 in the east, the remaining five 2nd to 6th nuclear tests from 2009 to 2017 were conducted in the detonation chambers inside the portal to tunnel no. 2 in the north under Mt. Mantap. Since there has never been a nuclear test inside the portal to tunnel no. 3 in the south or the portal to tunnel no. 4 in the west, they have attracted attention as the potential location for the 7th nuclear test.⁵

Concerns have also been raised about possible leakage and dissemination of radioactive materials. These concerns have been further heightened by several

⁵ Joseph S. Bermudez Jr., Victor Cha and Jennifer Jun, "New Activity at Punggye-ri Tunnel No. 4", *Beyond Parallel*, June 15, 2022, <https://beyondparallel.csis.org/new-activity-at-punggye-ri-tunnel-no-4>.

Map 1 The scale of 1st to 6th nuclear tests and their locations at the Punggye-ri nuclear test site⁶



⁶ For more information on the snail-shaped tunnel leading to the detonation chambers, see Frank Pabian, "The Punggye-ri Nuclear Test Site: A Test Tunnel Tutorial", 38North, May 23, 2018, <https://www.38north.org/2018/05/punggyetunnel052318>.

natural earthquakes and surface deformation that were confirmed after the 6th nuclear test. The US Geological Survey (USGS) and the Korea Meteorological Administration estimated that the cause of the local scale (ML) 4.1 earthquake that occurred about 8 minutes and 30 seconds after the 6th test was “a collapse”. An international joint Singapore-China-Germany-US research team analyzed that the ground had sunk by about 50cm.⁷ 38 North explained that: “because Mt. Mantap has been the location for the last five of six of North Korea’s declared underground nuclear tests (via the North Portal) and has undergone widespread observable surface disturbances resulting from the most recent test, it is not surprising that there were a number of post-test earthquakes. This may have caused some concern both inside and outside North Korea about ‘Tired Mountain Syndrome’.”⁸ The Tired Mountain Syndrome refers to a significant weakening of the ground due to continued nuclear testing.

Concerns were raised in South Korea’s National Assembly as well. Professor Lee Su-gon of the University of Seoul as an expert reference person stated that the continuous earthquakes after the 6th nuclear test suggested ground cracks and subsidence, radioactive leakage. He expressed his concern that “the scary thing is groundwater” and that “the groundwater is out of control”.⁹ At the National Assembly in 2019, Dr. Kim Bok-chul, president of the government-funded Korea Institute of Geoscience and Mineral Resources (KIGAM), also stated that “there is a high possibility” of the collapse of the underground tunnel structure and the contamination of groundwater by radioactive materials.¹⁰ Professor Suh Kune-yull of the Department of Nuclear Engineering at Seoul National University attended the National Assembly’s inspection of state administration as an expert reference person and explained that “It is granite, but the groundwater

⁷ Teng Wang, Qibin Shi, Mehdi Nikkhoo, Shengji Wei, Sylvain Barbot, Douglas Dreger, Roland Bürgmann, Mahdi Motagh and Qi-Fu Chen, “The rise, collapse, and compaction of Mt. Mantap from the 3 September 2017 North Korean nuclear test”, *Science*, Vol. 361, Issue 6398, May 10, 2018, pp.166-170, <https://www.science.org/doi/10.1126/science.aar7230>.

⁸ Frank Pabian and Jack Liu, “Is Mt. Mantap Suffering from “Tired Mountain Syndrome?”, *38 North*, October 17, 2017, <https://www.38north.org/2017/10/mtmantap101717>.

⁹ “2017년도 국정감사 환경노동위원회 회의록 [2017 parliamentary inspection of the National Assembly of the Republic of Korea Environment and Labor Committee minutes]” (meeting, Seoul, October 13, 2017), pp. 75-77.

¹⁰ “2019년도 국정감사 과학기술정보방송통신위원회 회의록 [2019 parliamentary inspection of the National Assembly of the Republic of Korea Science, ICT, Broadcasting, and Communications Committee minutes]” (meeting, Seoul, October 11, 2019), p.86.

is connected like threaded blood vessels”.¹¹ However, no investigation or research by the South Korean government on groundwater contamination or dissemination followed.

Meanwhile, North Korea has repeatedly insisted that no radioactive materials have leaked. For instance, immediately after the 5th nuclear test in 2016, North Korea claimed in Korean Central Television (KCTV) that there was no leakage of radioactive material or negative impact on the surrounding ecological environment. At the closing ceremony of the “Northern Nuclear Test Site” in May 2018, Kang Kyung-ho, deputy director of the Nuclear Weapons Research Institute, insisted that “there is no leakage of radioactive materials and the surrounding ecological environment is very clean”. Afterwards, a statement was issued in the name of the Nuclear Weapons Research Institute that “It has been confirmed that there was no leakage of radioactive materials or negative impact on the surrounding ecological environment”.¹²

However, North Korea has never provided scientific evidence to support such a claim or allowed external on-site measurements. In 2018, 30 journalists of 10 teams from 5 countries (South Korea, the US, China, Russia and the UK) were present at the closure of the unused tunnels no. 3 and no. 4, but nuclear experts were excluded.¹³

Bruce Bechtol, a professor at Angelo State University who had served as a senior analyst for the US Defense Intelligence Agency (DIA), stated that “It was the same concept as letting ordinary people into a murder crime scene and letting them trample around”. He added that the evidence that could have been collected would have disappeared by now.¹⁴

11 “2019년도 국정감사 외교통일위원회 회의록 [2019 parliamentary inspection of the National Assembly of the Republic of Korea Foreign Affairs & Unification Committee minutes]” (meeting, Seoul, October 17, 2019), p.53.

12 “조선민주주의인민공화국 핵무기연구소 성명 [Statement by the Nuclear Weapons Research Institute of the Democratic People's Republic of Korea]”, *DPRK Today*, <https://dprktoday.com/news/32866>.

13 “풍계리 핵실험장 폐기 의식에 5 개국 취재진 초청... 핵 전문가는 제외 [Reporters from 5 countries invited to the Punggye-ri nuclear test site closing ceremony; but nuclear experts excluded]”, *BBC Korea*, May 15, 2018, <https://www.bbc.com/korean/news-44111986>.

14 Jamie Tarabay, “To experts, North Korea dismantling nuclear site is like destroying evidence”, *CNN*, May 22, 2018, <https://edition.cnn.com/2018/05/22/asia/north-korea-destroy-nuclear-site-intl/index.html>.

The reporters had the opportunity to look around the entrance of tunnel no. 3 in the south. When they reached a stream in front of the tunnel, a North Korean reporter from Korean Central Television (KCTV) said “The pH (hydrogen ion concentration) of the water sold in Sindok Spring is 7.4, but this water has a pH of 7.15 and is better to drink. There is no radioactive contamination” and advised everyone to try it.¹⁵ However, when a foreign journalist said, “You first,” the North Korean reporter did not drink. The reporters brought radiation meters, but they were confiscated prior to the event.¹⁶

Had the meters not been confiscated, the water in the stream and the soil around the nuclear test site would have been worth testing for radioactivity. This is because in 2013, when North Korea conducted its 3rd nuclear test, researchers at the Alamos National Laboratory (LANL) in the United States confirmed through satellite images that water was continuously flowing from tunnel no. 3 in the south. Researchers who attempted to determine the existence of groundwater around the nuclear test site submitted a report to the US State Department with the following explanation and photo evidence.

There is a dearth of specific reporting on the ground water, water table depths and rock saturation in the vicinity of the Punggye-ri nuclear test. However, surface water can be regularly observed in the streambeds throughout the test site proper, and, more importantly, water is now apparently flowing consistently from the “South Portal”.¹⁷

The Changhung Stream originating from Mt. Mantap and the surrounding water systems

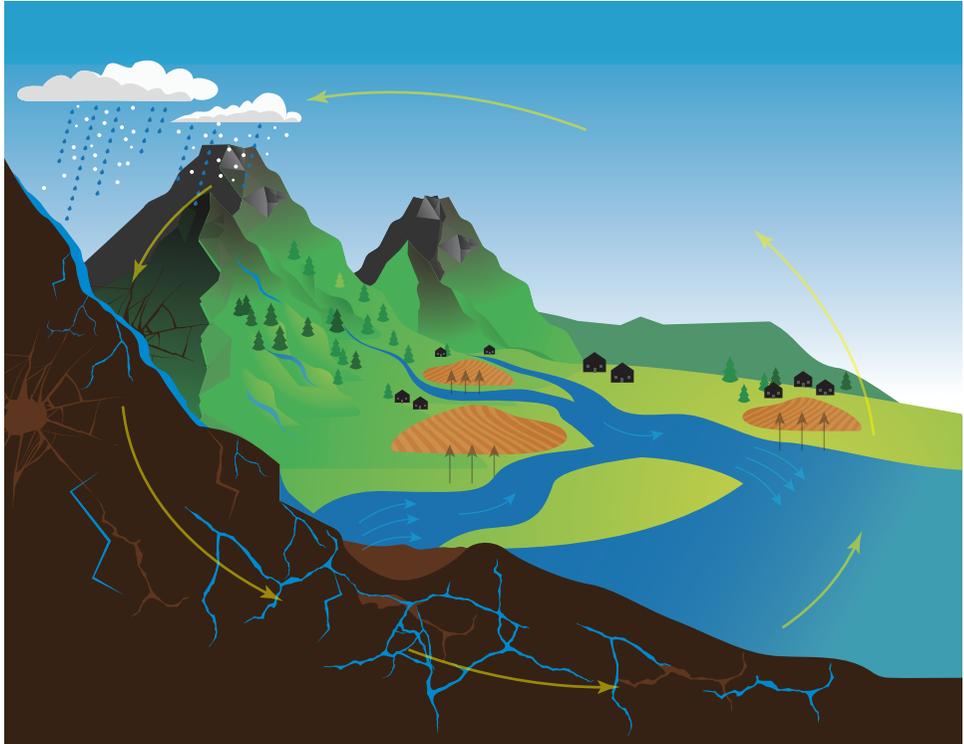
All surface water and groundwater originate from rainwater and interact

15 Yoo Jeehye, “방사능 측정기 빼앗기고는… 北 ‘갱도 앞 개울물 마셔보라’ [After confiscating radiation meters; North Korea suggests ‘drink water from a stream in front of tunnel’]”, *JoongAng Ilbo*, May 25, 2018, <https://www.joongang.co.kr/article/22656032>.

16 Yoon Sung-Min, “갱도앞 개울물 마셔보라던 北인사, ‘먼저 마셔보라’ 하니… [North Korean worker offered water from the stream in front of the tunnel to journalists, but when ‘asked to drink first...’]”, *JoongAng Ilbo*, May 28, 2018, <https://www.joongang.co.kr/article/22662846>.

17 David Coblenz and Frank Pabian, “Geologic Site Characterization of the North Korean Nuclear Test Site at Punggye-ri: A Reconnaissance Mapping Redux”, U.S. State Department Bureau of Arms Control, Verification, and Compliance Office of Verification and Transparency Technologies (2013), pp.42-43, <https://apps.dtic.mil/sti/citations/ADA625872>.

Figure 1 **The circulation of water and the interaction of surface water and groundwater**

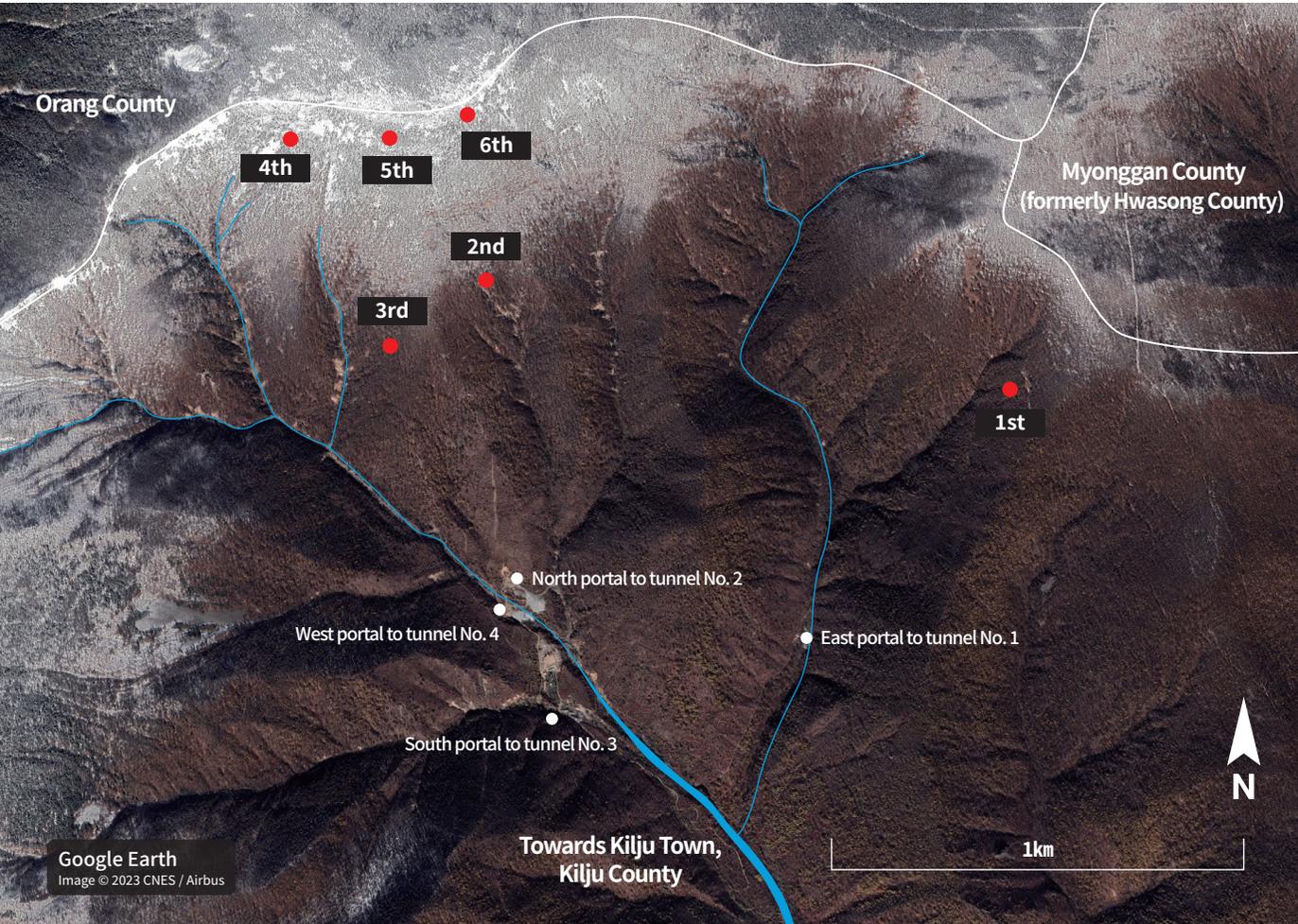


through the water cycle as shown in <Figure 1>. Exposed surface water and unexposed groundwater are not disconnected from each other but connect at some point to flow and circulate. The surface water and groundwater around the nuclear test site likewise join in several places and form streams.

<Map 2> shows that surface water is exposed around the 1st to 6th nuclear test sites and there is a confluence in front of the entrance to tunnel no. 3 in the south where a North Korean reporter told international reporters to drink stream water.

In particular, it is worth noting to where the water from Mt. Mantap (2,205m) flows. The Geographical Compendium of North Korea, published in North Korea in 1990, explicitly refers to this water system as the Changhung Stream.

Map 2 The confluence of surface water around the nuclear test site



<Map 3> shows a wider range. The Changhung Stream, which originates from Mt. Mantap, flows 20.5 km southward to connect to the Namdae Stream, which passes through Kilju Town, Kilju County, the most populous area along the water system, before forming the natural boundary between Hwadae County and Kimchaek City and emptying into the East Sea.¹⁸

¹⁸ The Namdae Stream is 102.7km long, 13.1km wide and 1,346.5km² deep. The most well-known flood damage occurred in 1919 and 1938. The midstream region (Jaedeok – Kilju) suffered from flood damage in 1957, 1965, and 1969 due to heavy rainfall. During the flood of August 1965, the maximum water flow reached 199m³/s in Punggye-ri, Kilju County (The Institute for Peace Affairs, *조선향토대백과 14: 함경북도 I [Encyclopedia of North Korean Geography and Culture]*, 2003, p. 28).

Map 3 The water systems originating from Mt. Mantap and connecting to the Changhung Stream and Namdae Stream



* Basemap © OpenStreetMap, Mapbox and Mapcarta¹⁹

¹⁹ The map and the waterways were created using Mapcarta website based on OpenStreetMap. For more information on OpenStreetMap's mapping method and its contributors, see <https://wonyoung.so/cartographers-nk>.

Abundant groundwater

Every summer in North Korea, the rainy season that lasts for weeks or months and a series of typhoons that pass through the Korean peninsula cause flooding throughout the country.

The area around the nuclear test site has experienced heavy rains and floods almost every year. For instance, North Korea faced criticism for seeking international assistance for a flood in North Hamgyong Province that resulted in hundreds dead or missing and 68,000 displaced, just five days before pressing ahead with its 5th nuclear test.²⁰ In the summer of 2019, torrential downpour and a series of typhoons caused large-scale damage such as roads around the nuclear test site being washed away and bridges being cut.²¹ In the summer of 2022, torrential terrain continued throughout North Korea for more than two months and the Center for Strategic and International Studies (CSIS) surmised from satellite images that “the restoration work for tunnel no. 4 at the nuclear test site appears to have been temporarily suspended due to heavy rain” and adding that “Some flood damage was detected on the only road that gives access to the facilities”.²²

Groundwater is abundant. Song Sung-Ho, Park Jongchul, and An Jung-Gi developed a GIS spatial filter to estimate the distribution of available amount of groundwater in North Korea and visualized it as in <Map 4>.²³ The area expressed in the darkest blue in North Hamgyong Province is Kilju County and it visualizes the particularly large amount of groundwater.

The research team estimated the available amount of groundwater in North

20 Kim Jun-Young, “北, 핵실험 직전 국제사회에 홍수 피해 구호 요청해 [North Korea asked international community for flood relief immediately before nuclear test]”, *YTN*, September 16, 2016, https://www.ytn.co.kr/_ln/0101_201609162206276179

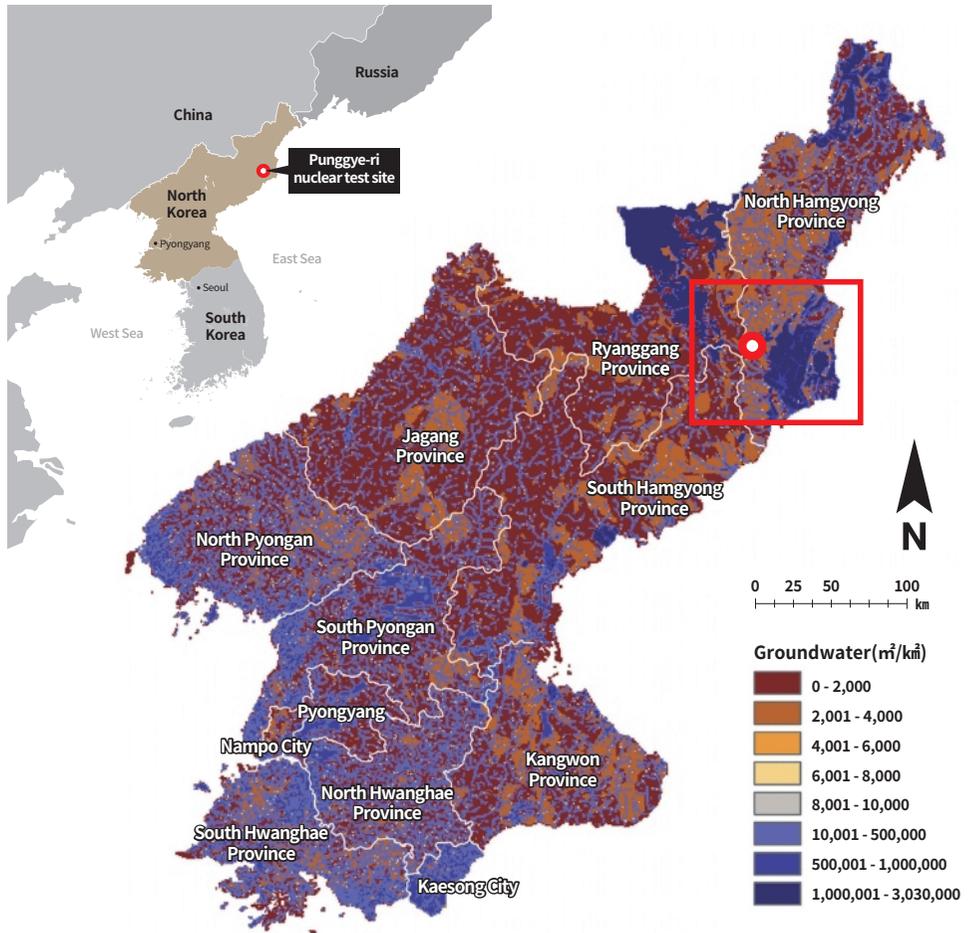
21 Jung Yong-Su, “38노스 ‘북, 수해피해 입은 풍계리 핵실험장 복구 중’ [‘North Korea restores flood-damaged Punggye-ri nuclear test site’ according to 38 North]”, *JoongAng Ilbo*, November 26, 2020, <https://www.joongang.co.kr/article/23930708>.

22 Joseph S. Bermudez Jr., Victor Cha and Jennifer Jun, “New Activity at Punggye-ri Tunnel No. 4”, *Beyond Parallel*, June 15, 2022, <https://beyondparallel.csis.org/new-activity-at-punggye-ri-tunnel-no-4>.

23 Song Sung-Ho, Park Jongchul, and An Jung-Gi, “Estimation of the Available Amount of Groundwater using Classifications of Landforms and Hydrogeological Units in N. Korea”, *Journal of Soil and Groundwater Environment*, 20, no.7 (2015), pp.22-33, <http://dx.doi.org/10.7857/JSGE.2015.20.7.023>.

Hamgyong Province to be about 4.6 billion m³, which accounts for 20% of the total available amount of groundwater in North Korea or about 22.3 billion m³. The available amount of groundwater per unit area in North Hamgyong Province was calculated to be approximately 270,000 m³/km². However, since estimates for cities and counties, which are sub-administrative districts of each province, are not presented, the amount of groundwater endowed in the area around the nuclear test site cannot be known in specific figures.

Map 4 Estimated distribution of available amount of groundwater in North Korea²⁴



²⁴ We have marked location of the nuclear test sites and identified each province on Song et al.'s 'Map for the estimated available amount of groundwater in N. Korea'.

The fact that there are many hot springs in Kilju County, Myongchon County, Kimchaek City and Orang County also supports the abundance of groundwater. Kilju County has the Onsupyong hot spring, the Kumsong hot spring and the Sipil hot spring; Myongchon County has the Yangjong hot spring, the Manho hot spring, the Bochon hot spring, the Daho hot spring, the Hwangjin hot spring, the Hwangjin mineral water, the Sarion hot spring; Kimchaek City has the Sechon hot spring, the Songhung hot spring and the Samro hot spring; Orang County has the Dolsu hot spring.²⁵

The use of groundwater as drinking and agricultural water

The North Korean escapees from Kilju County state that the North Korean government not once evacuated or warned the people while conducting 6 nuclear tests. In fact, the North Korean authorities keep the people in the dark about the risk of radioactive leakage and dissemination through groundwater. The findings by Database Center for North Korean Human Rights (NKDB), a South Korean NGO, in July 2018 also showed that “[the North Korean people’s] level of social awareness about the harm of radiation is low due to lack of information”.²⁶

The actual situation of water use is of particular concern. North Korea’s 2008 census results show that nearly one out of every six households (15.5 percent) in North Hamgyong Province, which includes Kilju County, uses groundwater, waterhole, public tap, spring, etc. as drinking water. In rural areas, the situation is even worse, reaching more than one out of every four households (26.2 percent). In particular, 10.7 percent of households uses “groundwater (choltchang or borehole with pump)” as drinking water, which is higher than North Korea as a whole (8.5 percent) let alone Pyongyang (3.3 percent).²⁷ According to the Geographical Compendium of North Korea, Kilju County “uses the abundant

²⁵ Encyclopedia of North Korean Geography and Culture, pp.26-27.

²⁶ Mun Dong Hui, “핵 개발 참여 北 주민 사망까지... 당국, 위험성 알리지 않아 [North Koreans involved in nuclear development even die... the authorities don’t tell the danger]”, *Daily NK*, July 18, 2018, <https://www.dailynk.com/핵-개발-참여-北-주민-사망까지-당국-위험성-알리지>.

²⁷ The North Korean word *choltchang* refers to a facility that drives a pipe into the ground and pumps up groundwater. The lower part of the pipe contains a filter that only allows groundwater to enter the pump while the upper part contains a vacuum pump to extract water from the ground.

groundwater for irrigation of *bitalddang* and *tokjidaebuchimttang* by installing wells and *gulpo*.²⁸ There are 62 wells in Pyongryuk-ri and 45 in Namyang-ri, accounting for 62 percent of the number of wells in Kilju County”.²⁹

Table 1 The composition of the supply source of drinking water by residential unit (2008)

Unit: percent (%)

	North Hamgyong			DPR Korea			Pyongyang		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Piped water into dwelling unit	84.5	89.0	73.8	85.0	89.5	78.0	93.3	95.7	77.9
Public tap	1.5	1.6	1.2	2.3	2.3	2.3	1.8	1.4	4.7
Tube well/borehole with pump [groundwater (choltchang)]	10.7	7.0	19.4	8.5	5.7	12.9	3.3	1.8	12.3
Protected waterhole	1.9	1.4	3.0	2.7	1.7	4.3	0.8	0.4	2.7
Protected spring	1.0	0.7	1.7	1.0	0.6	1.6	0.1	0.1	0.2
Others	0.5	0.3	0.9	0.5	0.3	0.9	0.7	0.5	2.1

Source: DPR Korea 2008 Population Census (Pyongyang: Central Bureau of Statistics, 2009), pp.252-253.

However, the 2008 census results provide information at the level of large administrative units like Pyongyang special city and provinces; they do not include information at the level of smaller administrative units like normal cities or counties.

In reality, there may be more households using groundwater, wells, etc. as drinking water. This is because electricity is needed to stably use the piped water at home. In North Korea, power shortages have become the norm across the country and the limited supply of electricity first goes to factories and enterprises before households. Even in Pyongyang, always prioritized in resource allocation, electricity is supplied on a part-time basis except for some high-end residential areas; the situation in the provinces is worse. Therefore, the

²⁸ *Bitalddang*, *tokjidaebuchimttang*, and *gulpo* are North Korean words for a slope, flat cultivated land situated higher than a plain, and a puddle made to irrigate the fields respectively.

²⁹ Kang Eung-Ju, *조선지리지전서: 함경북도* [The Geographical Compendium of North Korea: North Hamgyong Province] (Pyongyang: Educational Books Press, 1990), p.630.

choice of piped water at home as the drinking water source in the census may hide a high chance of dependence on groundwater, wells, etc.

A North Korean escapee who had lived in Kilju Town, the center of Kilju County, provided anecdotal evidence for this. She lived in an apartment with relatively good living conditions, but the piped water was useless from the second floor up because of the weak water pressure and most residents got their drinking water from a joint well.³⁰

Immediately after North Korea's 5th nuclear test in 2016, concerns about the danger of contamination of the drinking water was raised in the South Korean National Assembly. At the inspection of state administration, Minister of Unification Hong Yong-pyo stated that "Since the people living in Kilju County drink the water coming from Punggye-ri, this is something that is suspicious now". He also explained that "a more detailed investigation appears necessary and thus the relevant matters are being reviewed".³¹ However, it has not been confirmed whether the Ministry of Unification conducted such an investigation afterwards.

If and when the South Korean government decide to investigate the risk and effect of radiation exposure for the North Korean escapees who had lived near the Punggye-ri nuclear test site, it is necessary to ask them in detail about the drinking water sources in North Korea in addition to medical examinations. Given the lack of on-site access in North Korea, this may be an indirect but realistic way to conduct an epidemiological investigation. Moreover, a special attention needs to be paid to whether the radiation exposure is greater among the rural residents, who are more likely to use groundwater, wells, etc., as drinking water compared to the city dwellers.

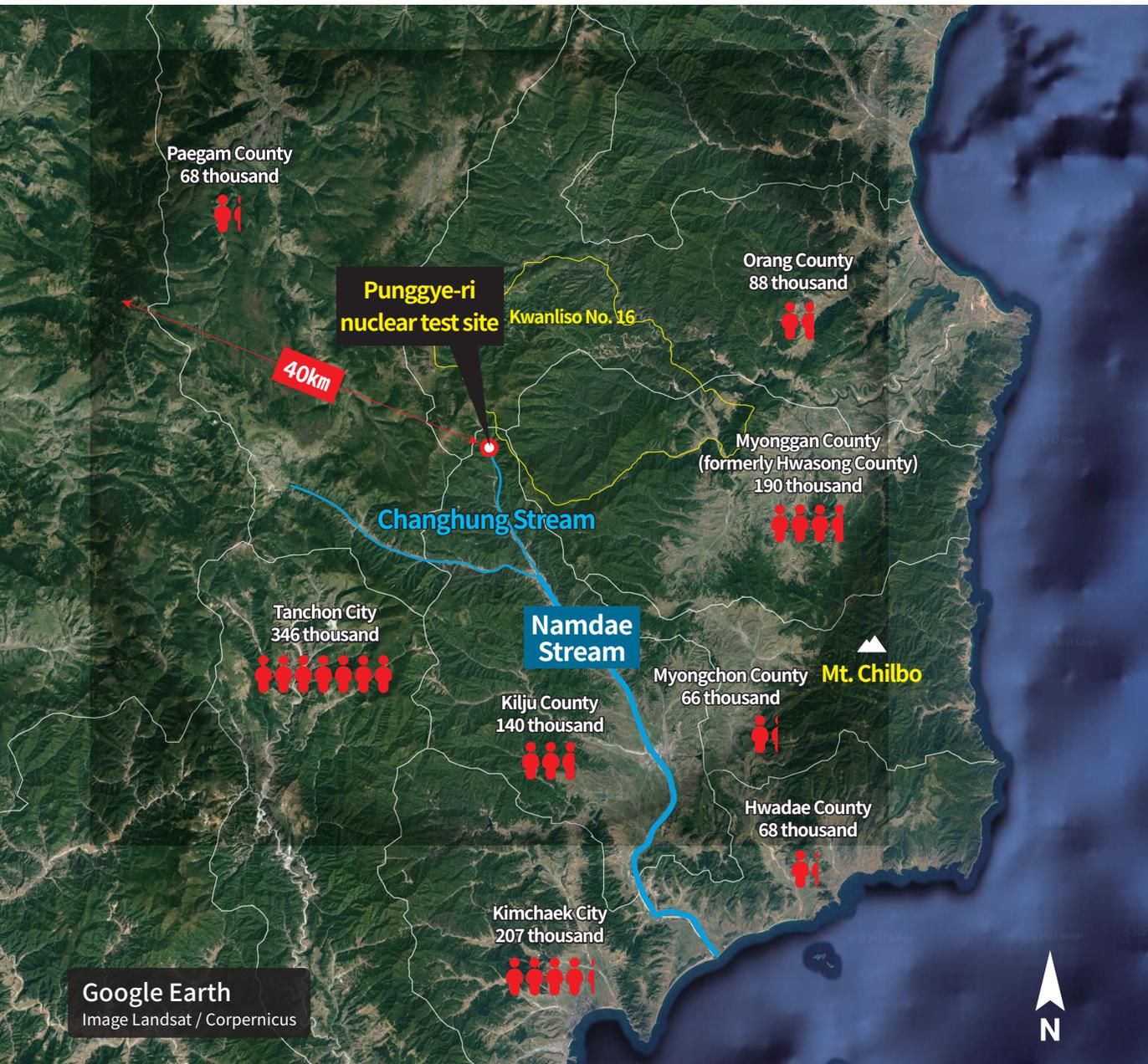
Areas and populations at risk

Most radioactive materials can be absorbed in soil and flow through rainwater

³⁰ Interview with a North Korean escapee, interview by Transitional Justice Working Group, Seoul, January 10, 2023.

³¹ "2016년도 국정감사 외교통일위원회 회의록 [2016 parliamentary inspection of the National Assembly of the Republic of Korea Foreign Affairs & Unification Committee minutes]" (meeting, Seoul, September 27, 2016).

Map 5 Areas within a 40km radius of the Punggye-ri nuclear test site and the areas affected by the Changhung Stream and the Namdae Stream³²



³² For city/county boundaries, see 38 North DPRK Digital Atlas (<https://38northdigitalatlas.org/>). For English spelling of the names of cities and counties, see *DPR Korea 2008 Population Census* (Pyongyang: Central Bureau of Statistics, 2009), https://unstats.un.org/unsd/demographic/sources/census/wphc/North_Korea/Final%20national%20census%20report.pdf.

or seep into groundwater to disseminate. If radioactive materials have leaked from a nuclear test site and have disseminated through water, which areas and populations would be at risk?

Let's first consider the area within a 40 km (24.85 mile) radius. This range is commonly used for atmospheric nuclear tests and nuclear facility accidents although it may not be appropriate for underground nuclear tests. But North Korea's underground nuclear test site is different from that of other countries. For instance, the underground nuclear test sites in the United States and China are in desert areas where groundwater is scarce. By contrast, the Punggye-ri nuclear test site is in an area with abundant rainfall and groundwater.

Since it is not possible to accurately identify the underground water veins by approaching Punggye-ri, the assumption will be that groundwater may flow in all directions and not only in certain directions. Therefore, it would make sense to mark a possible range of radioactive contamination through water by drawing a circle around Punggye-ri. Within a 40km radius are the main residential areas of Kilju County, Myonggan County (formerly Hwasong County)³³, Myongchon County, Paegam County and Tanchon City.

However, the area within a 40 km radius is not the only area of concern. Radioactive materials can leak into the surface water and groundwater and disseminate to a greater distance along the water systems. Therefore, the major residential areas of Kilju County, Hwadae County and Kimchaek City formed along the Namdae Stream are included in the areas at high risk of contamination through water.

How many people live in the areas at risk of radioactive contamination? The information released by North Korea is very limited, but it has conducted nationwide censuses in 1993 and 2008 and submitted the census results to the United Nations.³⁴ The 2008 census data will be used for this survey. There

33 Myonggan County was renamed to Hwasong County in 1981; however, it has been confirmed that Pyongyang Broadcast Service and the Korean Central Broadcasting Station referred to the province as "Myonggan-gun" in April 2005.

34 *DPR Korea 1993 Population Census* (Pyongyang: Central Bureau of Statistics, 1994); *DPR Korea 2008 Population Census* (Pyongyang: Central Bureau of Statistics, 2009).

will be discrepancies with the current population as the data is 15 years old and there are several limitations such as the unrealistic imbalance in the sex ratio and the possible omission of military personnel and prison population. However, the 2008 census data is still useful for estimating the approximate population.

Table 2 The population of areas within a 40km radius of the Punggye-ri nuclear test site and the areas affected by the Changhung Stream and the Namdae Stream (2008)

Unit: person

		All Areas	Urban	Rural
North Hamgyong Province	Kilju County	139,932	53% (74,154)	47% (65,778)
	Hwadae County	67,677	22% (15,095)	78% (52,582)
	Kimchaek City	207,299	75% (155,284)	25% (52,015)
	Myonggan County (formerly Hwasong County)	99,557	50% (49,968)	50% (49,589)
	Myongchon County	65,797	51% (33,439)	49% (32,358)
	Orang County	87,757	40% (35,202)	60% (52,555)
South Hamgyong Province	Tanchon City	345,875	70% (240,873)	30% (105,002)
Rygang Province	Paegam County	67,683	68% (46,256)	32% (21,427)
	Total	1,081,577	60% (650,271)	40% (431,306)

Source: DPR Korea 2008 Population Census (Pyongyang: Central Bureau of Statistics, 2009), p.18.

The high ratio of the rural population in Hwadae County and Orang County may be due to the fishing villages along the East Sea while the high ratio of the urban population in Paegam County may be due to the Paegam Workers' District which is located 22km to the west of the Punggye-ri nuclear test site.

<Table 2> shows the population of the 8 cities and counties (Kilju County, Hwadae County, Kimchaek City, Myonggan County, Myongchon County, Orang County, Tanchon City and Paegam County) of 3 provinces (North Hamgyong Province, South Hamgyong Province and Rygang Province) by administrative division that fully or partially falls under the areas within a 40km radius of the Punggye-ri nuclear test site or the areas affected by the

Changhung Stream and the Namdae Stream according to the 2008 census data.

The total population of the 8 cities and counties adds up to approximately 1.08 million. However, there are likely to be residents living outside of a 40km radius of the Punggye-ri nuclear test site and away from the Changhung Stream and Namdae Stream who are not affected. Taking this into consideration, out of approximately 1.08 million people, the affected population would be approximately 540,000 or 270,000 under the assumption that 50 or 25 percent respectively has been affected. Considering the number of deaths over the 17 years since the start of the nuclear tests in 2006, the affected population may be higher.

It is not known whether the prisoners at Kwanliso (political prison camp) No. 16 adjacent to the nuclear test site were included in the census of Myonggan County (formerly Hwasong County). From 3.3km to the east of the Punggye-ri nuclear test site spans the Kwanliso No. 16 area. The number of prisoners is known to be approximately 28,700. For long, suspicions have been raised that the inmates of this Kwanliso have been used for the construction of the tunnels and other activities at the nuclear test site. The 2014 COI report also notes the proximity of the Punggye-ri nuclear test site to Kwanliso No. 16:

Political Prison Camp No. 16 covers about 560 square kilometres of rugged terrain in Myonggan, North Hamgyong Province. It is located in close proximity to the P'unggye-ri nuclear test site. First-hand witness testimony indicates that the camp has existed since the 1970s, although it was much smaller at that time. Inmates live in two settlement areas in the northwestern and southeastern areas of the camp.³⁵

In 2013, Amnesty International released satellite images of Kwanliso No. 16 with the explanation that the addition of new housing buildings compared to 2008 indicates an increase in the prison population.³⁶ In 2022, Daily NK, a

³⁵ The COI report revealed that the GeoCoordinates for the central area of *Kwanliso* No.16 are 41.1849N 129.2032E (United Nations Human Rights Council, ¶ 735).

³⁶ For analysis of satellite images of *Kwanliso* No. 16, see Amnesty International, *North Korea: New Satellite Images show continued Investment in the Infrastructure of Repression* (2013), <https://www.amnesty.org/en/library/info/ASA24/010/2013/en>

news media specializing on North Korea, quoted an internal source in North Korea to report that the number of prisoners at Kwanliso No. 16 increased from 24,000 in July 2021 to 28,700 in June 2022.³⁷

³⁷ Mun Dong Hui, “북한 정치범수용소 수감 인원 지난해比 2만여 명 감소 [N. Korea’s political prison camp population has fallen by around 20,000 compared to last year]”, *Daily NK*, August 26, 2022, <https://www.dailynk.com/20220826-5/>.

THE RISK OF RADIOACTIVE EXPOSURE THROUGH IMPORTS IN NEIGHBORING COUNTRIES

The contamination risk of agricultural and marine products and specialties

The surface water affects agricultural products while the river water which empties into the sea affects the marine products. In this process, harmful substance can contaminate agricultural and marine products and cause harm to human health. Therefore, the leakage of radioactive materials from the Punggye-ri nuclear test site concerns the contamination of not only the drinking water but also of the agricultural and marine products.

The agricultural and marine products as well as specialties from various localities are described in detail in the Geographical Compendium of North Korea, published as secret materials by the North Korean government in 1990, and the Encyclopedia of North Korean Geography and Culture, published jointly by North and South Korea in 2003. One of the most notable local specialties is the pine mushroom. According to Ryugyong, one of North Korea's state-run external propaganda website, "Pine mushrooms are renowned specialties of North Korea ... as the best mushrooms in the world in terms of their edible value and pharmacological properties".³⁸ Alcoholic drinks made from pine mushrooms have been commonly sold in overseas restaurants run by North Korea in China, Cambodia and elsewhere.

Mushrooms that grow well in clusters of pine trees have the characteristic of absorbing radioactive cesium (Cs) in the air. <Map 6> shows the pine mushroom

³⁸ Kim Subin, "송이버섯: '버섯의 나라' 북한에서 보내온 깜짝 선물 [Pine mushrooms: A surprise gift from North Korea, 'country of mushrooms']", *BBC Korea*, September 21, 2018, <https://www.bbc.com/korean/news-45597021>.

Map 6 Pine mushroom areas around the Punggye-ri nuclear test site



distribution around the Punggye-ri nuclear test site mentioned in the Encyclopedia of North Korean Geography and Culture.

Pine mushrooms in North Korea have been branded and internationally distributed as “Mt. Chilbo”. The summit of Mt. Chilbo is approximately 53 km from the Punggye-ri nuclear test site. However, the North Korean escapees from Kilju County and Paegam County interviewed by TJWG stated that the locals picked large amounts of pine mushrooms from the lush clusters of pine trees in Mt. Mantap and the Punggye-ri area. They also mentioned that while it became difficult for them to access Mt. Mantap after it became a restricted area, they continued to pick mushrooms from other mountains nearby.³⁹

If the radioactive materials disseminate through water, it can also affect the agricultural products from the Kilju plain and the marine products from nearby seas. The Changhung Stream originating from Mt. Mantap connects to the Namdae Stream which is widely used as agricultural, industrial and residential water in the downstream area as well as industrial and residential water.⁴⁰ The Namdae Stream passes through Kilju County and flows between Hwadae County and Kimchaek City before it flows into the East Sea. According to the Encyclopedia of North Korean Geography and Culture, “The processed fish products in North Hamgyong Province are mainly produced in Kimchaek City, Orang County, Hwadae County, etc.” and “in Kimchaek City, various products such as frozen fish, salted fish, dried fish, fish meal, canned food, fish oil and fish fertilizer are produced”.⁴¹ Of particular concern are the seaweed as well as shellfish in the coasts of Hwadae County and Kimchaek City. Seaweeds like the sea mustard and kelp in particular are at a higher risk of contamination because they remain unaffected by the currents unlike fish that are constantly on the move from one sea to another.

Agricultural and marine products from the areas around the Punggye-ri nuclear

³⁹ Interview with a North Korean escapee, January 10, 2023; Interview with a North Korean escapee, interview by Transitional Justice Working Group, Seoul, January 12, 2023.

⁴⁰ *Encyclopedia of North Korean Geography and Culture*, p.28.

⁴¹ *Ibid.*, p.33.

test site are consumed by local community while the local specialties are distributed to other regions and overseas. The North Korean government has been using the local specialties as a highly profitable way to earn foreign currency, but products and scale of the overseas distribution have not been properly understood. The status of legal trade is difficult to know as the North Korean government does not disclose relevant information; illegal distribution is even more difficult to track.

Smuggling through the North Korea-China border area and distribution in neighboring countries

North Korea has been exporting and smuggling its popular local specialties to China, South Korea and Japan for decades. The trade of these specialties occurs mainly in the North Korea-China border area and goes through a multi-level distribution process.

1. North Korea → China → (South Korea & Japan)

Since the establishment of the Democratic People's Republic of Korea (North Korea) in 1948, China has been North Korea's main land and sea route for imports and exports. Most agricultural and marine products from North Korea exported to earn foreign currency for the North Korean government first consolidate in China.

China tries to maintain friendly relations with North Korea for security and geopolitical reasons. Although China avoids taking tough action against North Korea's nuclear tests, it temporarily blocked the import of agricultural and marine products from North Korea after its 1st nuclear test in 2006. Since then, China has repeatedly imposed temporary trade restrictions followed by its resumption in response to North Korea's nuclear tests. As the international community's sanctions against North Korea tightened, the North Korea-China border trade went underground, but North Korea's international distribution system through China has been maintained. In July 2015, Radio Free Asia (RFA) reported that 41 seafood processing companies in Hunchun, Jilin Province, China alone processed seafood from North Korea and Russia to produce more than 300,000 tons, half of which were exported to the United

States and Europe.⁴²

However, immediately after North Korea's 6th nuclear test in 2017, the Chinese government responded with great concern over the leakage and dissemination of radioactive materials. The Chinese media reported that the Chinese government has strengthened radioactive leakage tests in the Sino-North Korean border area. China's Ministry of Environmental Protection stated that "We have fully strengthened radioactive environmental investigations throughout the border area by a 24-hour survey method" and that "In the sensitive regions of the border area, not only the radiation dose in the air but also the radiation dose in drinking water sources, surface water, groundwater and soil have also been investigated and analyzed". Moreover, even the Central Military Commission of the Chinese Communist Party (CCP) and other organs used not only the designated inspection stations but also aviation inspection equipment.⁴³

Even prior to North Korea's 6th nuclear test, China's Korea experts expressed concerns about the dissemination of radioactive contamination through groundwater and other sources. Lu Chao, a researcher at the Liaoning Academy of Social Sciences, pointed out that "Because North Korea's core equipment at the nuclear facilities was smuggled in and fitted together over a long period of time, if there is radiation leakage, it will contaminate the air, soil and groundwater and endanger the safety of the residents in the Sino-North Korean border" on Phoenix TV in China.⁴⁴

After North Korea's launching of its first intercontinental ballistic missile Hwasong-14 in July 2017, the United Nations Security Council banned the import and export of North Korea's seafood as well as coal, iron, lead and other

42 Park Jung Woo, "중국서 북한산 해산물 가공업 호황 [North Korean seafood processing industry blossoms in China]", *Radio Free Asia*, July 6, 2015, https://www.rfa.org/korean/in_focus/food_international_org/fishfactory-07062015164421.html.

43 Yun Wan-Jun, "'北 핵실험장 경도 붕괴'... 中, 동북지역 방사능오염 초긴장 ['Tunnel to North Korea's nuclear test site collapses' possibly leading to radioactive contamination in northeastern China]", *The Dong-a Ilbo*, September 6, 2017, <https://www.donga.com/news/Politics/article/all/20170906/86186344/1>.

44 Jin Byung-Tae and Hong Chang-Jin, "북핵실험 우려에 北집경 中주민 '전전긍긍'...방사능공포 확산 [Chinese residents near the North Korean border 'trembling with fear' and concerns of radioactivity rising due to North Korean nuclear tests]", *Yonhap News Agency*, April 25, 2017, <https://www.yna.co.kr/view/AKR20170425105600097>.

goods. China too banned the import of seafood from North Korea, but did not block the import of agricultural goods, merely strengthening the quarantine and inspection.⁴⁵ Even the banned seafood was smuggled to China in tons every day.⁴⁶ In August 2018, it was even reported in the South Korean media that two different Chinese websites, one in Korean and the other in Chinese, were selling marine products from North Korea through Baidu, China's largest search engine.⁴⁷

2. North Korea → (China) → South Korea

Inter-Korean trade began in 1998,⁴⁸ but South Korea's imports of agricultural and marine products from North Korea began to increase rapidly in June 2000 ahead of the first summit between President Kim Dae-jung and Chairman Kim Jong-il. The first-ever inter-Korean summit peaked the public's interest and the popularity of North Korea's agricultural and marine products soared as they were 30 percent cheaper than the South Korean ones. For the traditional Chuseok holiday in September 2000, major department stores rushed to sell agricultural and marine products from North Korea including oakwood mushrooms, dried pollacks, bellflowers and brackens as "Inter-Korean Match Set" and "Unification Table Collection".⁴⁹ As inter-Korean trade is regarded as trade within a nation, the North Korean products are imported duty free.

After North Korea's 1st nuclear test in 2006, South Korea took no action in contrast to China and Japan which banned all imports of agricultural and

45 Hong Chang-Jin, "중단동 호시무역구도 '대북제재'...북한산 수입농산물 검역강화 [The Dandong China-North Korea border trade zone in China also imposes 'sanctions against North Korea', reinforcing quarantine on agricultural imports from North Korea]", *Yonhap News Agency*, September 28, 2017, <https://www.yna.co.kr/view/AKR20170928101900097?input=1195m>.

46 An Seung-Sup, "안보리 제재 '무색한' 북중접경...북한 수산물 중국 밀수 여전' [Security Council's sanctions remain 'ineffective' along the North Korea-China border as smuggling of North Korean seafood continues]", *Yonhap News Agency*, September 1, 2017, <https://www.yna.co.kr/view/AKR20170901046600074>.

47 Kang Byung-Gu, "중국 최대 포털 바이두 대북제재 위반 사실 포착, 북한 수산물 유통시켜 [Baidu, China's largest search engine, caught violating sanctions against North Korea and distributing its seafood]", *News Today*, August 20, 2018, <https://www.news2day.co.kr/article/20180820109187>.

48 "北韓수산물 반입급증 [Rapid increase in imports of North Korean seafood]", *Busan Ilbo*, October 8, 1991, <https://www.busan.com/view/busan/view.php?code=19911008000049>.

49 "한가위... 중국산 '썰물' 북한산 '밀물' [Chuseok... 'low tide' from China, 'high tide' from North Korea]", *Kukmin Ilbo*, September 9, 2000, <https://news.kmib.co.kr/article/viewDetail.asp?newsClusterNo=01100201.20000909000001801>.

marine products from North Korea. As imports of marine products from North Korea continued to grow, a question was raised in the National Assembly whether the government knew what marine products were caught in the nearby sea of the Kilju area and entered South Korea.⁵⁰ Ministry of Maritime Affairs and Fisheries Kim Sung-jin replied that “I do not know the specific items, but it is mostly shellfish, most of which are clams”. He also stated that “There have been no instances of radioactive substance being detected above the standard level”.⁵¹ Agricultural and marine products continued to be imported without any restrictions in South Korea and a summit between President Roh Moo-hyun and Chairman Kim Jong-il was held in 2007.

Even after the inauguration of President Lee Myung-bak in 2008, the South Korean government continued to allow imports of North Korean agricultural and marine products after North Korea’s second nuclear test in May 2009. However, following the sinking of the South Korean navy vessel Cheonan which took the lives of 46 of 104 crew members in March 2010, agricultural and marine imports were banned under the “May 24 sanctions” against North Korea. Nonetheless, the “bundle vendors” (small-time merchants who engage in unauthorized cross-border trading) continued to import inexpensive North Korean specialties by disguising them as Chinese products. Pine mushrooms disguised as Chinese products were not only cheap but marketed as “made in North Korea” in private transactions in traditional markets, online shopping malls and the North Korean escapees’ community because of the South Korean consumers’ perception that they would be less exposed to pollution in less developed North Korea.⁵²

50 Asked by Assemblyman Kim Hyung-o (“2006년도 국정감사 농림해양수산위원회 회의록 [2006 parliamentary inspection of the National Assembly of the Republic of Korea Agriculture, Food, Rural affairs, Oceans & Fisheries Committee minutes],” (meeting, Seoul, November 1, 2006), pp.6-9.).

51 Under the South Korea Food Sanitation Act, the standard at the time was 300 Bq(becquerel)/kg for radioactive iodine (Iodine-131) and 370 Bq/kg for radioactive cesium (Cesium-134 & Cesium-137). This standard was established in April 1986 to manage food imports from European regions located near Ukraine post the Chernobyl nuclear power plant accident. From April 2012, South Korea applied stricter standards (100 Bq/kg for both radioactive iodine and cesium) for imported goods from Japan due to the 2011 Fukushima nuclear accident. This standard was adopted to assess all imported goods starting in April 2019.

52 Kim Su-Kyung and Lee Hui-Kwon, “암거래되는 북한산 송이버섯. 진짜 북한산 맞나 [Are North Korean pine mushrooms sold on the black market really from North Korea?],” *The Chosun Ilbo*, February 18, 2017, https://www.chosun.com/site/data/html_dir/2017/02/17/2017021702240.html.

In 2015, the South Korean government announced for the first time that radioactive materials have been detected in agricultural products smuggled from North Korea disguised as Chinese products. According to the Ministry of Food and Drug Safety, 981Bq/kg or more than 9 times the standard level of radioactive cesium isotopes (Cs-134 and Cs-137), which is 100Bq/kg, was found in North Korea-produced dried hedgehog mushrooms. These mushrooms were brought into South Korea by “bundle vendors” without an import declaration from China.⁵³ Since radioactive cesium is produced as a result of nuclear fission, the connection with North Korea’s nuclear test was suspected but the area of origin within North Korea was not identified.

In 2018, 2 tons (2,000 kg) of pine mushrooms, which President Moon Jae-in had received from Chairman Kim Jong-un as a gift during his visit to Pyongyang and brought home on his plane, became a source of controversy. At the earlier inter-Korean summits in 2000 and 2007, Chairman Kim Jong-il had presented 3 tons and 4 tons of pine mushrooms to Presidents Kim and Roh respectively, but President Moon sent 500 grams each to about 4,0000 elderly separated families as Chuseok holiday gifts. Such action raised the criticism that it was done without radiation testing.⁵⁴

It was revealed that the Ministry of Unification gave the comprehensive approval for bringing the pine mushrooms into South Korea while the Customs Service and the Ministry of Agriculture, Food and Rural Affairs accepted oral declarations.⁵⁵ The Presidential Office claimed to have conducted radiation tests, but it is unclear if they submitted the detailed test data as requested at

53 Kim, an ethnically Korean resident in China, brought 10kg of North Korean hedgehog mushrooms to South Korea without declaring the goods. Two domestic sellers sold 8kg to the general public. The Ministry of Food and Drug Safety collected and tested the remaining 2kg, revealing that an exceeding amount of cesium was found in the sample (South Korea’s Ministry of Food and Drug Safety, “북한산 건조 능이버섯 방사능 기준 초과 검출 [Excess amount of radioactivity detected in North Korean hedgehog mushrooms]”, *South Korea Policy Briefing*, November 27, 2015, <https://www.korea.kr/news/pressReleaseView.do?newsId=156087630>).

54 Choi Hyung-Chang, “추석 밥상 달군 김정은 송이버섯... ‘귀한 음식’ vs ‘방사능 검사 했다’ [Kim Jong-un’s pine mushrooms popular during Chuseok... ‘Precious delicacy’ vs. ‘Mushrooms without radiation tests?’]”, *Segye Ilbo*, September 24, 2018, <https://www.segye.com/newsView/20180924001254>.

55 Asked by Assemblyman Kim Sung Won (“2018년도 국정감사 정무위원회 회의록 [2017 parliamentary inspection of the National Assembly of the Republic of Korea National Policy Committee minutes]” (meeting, Seoul, October 10, 2018), p.80).

the National Assembly.⁵⁶ The Presidential Office's use of sievert (Sv), which measures the amount of radiation absorbed by the human body, instead of Bq (becquerel)/kg, which measures radioactive iodine and cesium in food, to explain the test results also raises doubts.⁵⁷

3. North Korea → (China) → Japan

Unlike South Korea, Japan banned all imports from North Korea after North Korea's 1st nuclear test in 2006 and additionally banned all exports to North Korea after the 2nd nuclear test in 2009.

However, agricultural and marine products from North Korea continue to be smuggled into Japan disguised as Chinese products. In September 2009, Fuji TV reported how North Korean pine mushrooms were disguised as Chinese ones by "switching the packaging" at a market in Yanji, Jilin Province in China. It was reported that the local pine mushroom merchants admitted that the smuggling continues because North Korean pine mushrooms which cost 1/10 of the Japanese ones are in heavy demand from Japanese grocers. Fuji TV called it "pine mushroom laundering".⁵⁸

The Japanese government has suspected that the pro-Pyongyang General Association of Korean Residents in Japan (Chongryon) serves as a smuggling channel. In May 2015, the Japanese police arrested Kim Yong-jak, the president of Korean Specialties Sales, a food whole company under the control of Chongryon, for smuggling pine mushrooms from North Korea by falsifying

⁵⁶ Assemblywoman Kim Seunghee pointed out that the eligible standard for private consumption of mushroom is 5kg max. She stressed that it is difficult to say the government is putting safety of the people as its priority when it brought 2000kg of mushroom across the border. She demanded the Ministry of Food and Drug Safety to take appropriate measures for improvements. She also said, "If they were to say 4,000 defectors ate [the mushrooms] with their families, that's already 8,000 people in family of twos, and 12,000 people in family of threes. It is problematic to view such quantity as private consumption" ("제364회 상임위원회(정기회) 국회 예산결산특별위원회 회의록 제 8호 (부록) [364th Regular session of the National Assembly of the Republic of Korea Special Committee on Budget & Accounts minutes no. 8 (Appendix)]" (meeting, Seoul, November 12, 2018), pp.47-48).

⁵⁷ "靑 '북한산 송이버섯 방사능 이상 없어' [The Presidential Office says no radioactivity problem detected in North Korean pine mushrooms]", *KTV News*, 00:39, November 7, 2018, https://www.ktv.go.kr/news/major/view?content_id=563844.

⁵⁸ Kim Yonho, "북한산 송이버섯, 중국산 둔갑해 일본에 밀수입 [Pine mushrooms from North Korea smuggled into Japan disguised as Chinese imports]", *Voice of America*, September 14, 2009, <https://www.voakorea.com/a/a-35-2009-09-14-voa14-91364729/1321650.html>.

them as Chinese ones. At the same time, the police arrested Heo Jeong-do, the second son of Heo Jong-man who is the chairman of Chongryon, for violation of the foreign exchange law. The Japanese police searched Heo's house and seized the transaction documents between Chongryon and Office No. 39 of the Workers' Party of Korea (WPK) in North Korea which stated that "The export of pine mushrooms will be executed as a state project and the Korean Specialties Sales will receive the pine mushrooms". Office No. 39 of the Workers' Party of Korea (WPK) has won notoriety as the channel for raising slush funds for North Korea's successive supreme rulers including Kim Jong-un.⁵⁹

In December 2015, the Kyoto District Court sentenced Kim to 2 years in prison suspended for 4 years, Heo to 1 year and 8 months in prison suspended for 4 years, and Korean Specialties Sale to a fine of 2 million yen (16.6 thousand USD). The court stated that the smuggling of North Korean pine mushrooms via China took place in September 2010 and involved 3 tons.⁶⁰

It is not known whether the Japanese authorities conducted tests to check for contamination by radioactive substance.

⁵⁹ "金正日氏が許議長にマツタケ利権独占密約、朝銀破綻駆け込み「120億円」貸与の見返り", *The Sankei Simbun*, May 14, 2015, <https://www.sankei.com/article/20150514-FCFGOAN4BMSHALUA4SKJPJAV4/>; Kim Yonho, "일본 언론 '조총련, 북한 39호실과 송이버섯 밀수' [Japanese media says 'the General Association of Korean Residents in Japan and the Central Committee Bureau 39 of the Workers' Party of Korea smuggles North Korean pine mushrooms']", *Voice of America*, May 27, 2015, <https://www.voakorea.com/a/2791245.html>.

⁶⁰ Cho Eunjung, "일 법원, '북한송이 밀수' 조총련 의장 차남 유죄 판결 [Japanese court finds son of the General Association of Korean Residents in Japan chief guilty of 'importing North Korean pine mushrooms']", *Voice of America*, December 11, 2015, <https://www.voakorea.com/a/3097491.html>.

CHROMOSOMAL ABNORMALITIES AND HIGH RADIATION DOSE IN THE RESULTS OF THE RADIATION EXPOSURE TESTS FOR NORTH KOREAN ESCAPEES

While the efforts to find and inspect North Korean agricultural and marine products and to locate the area of origin within North Korea are meaningful, a more direct and effective method in epidemiological terms would be to test the North Korean escapees from the areas near the Punggye-ri nuclear site for radiation exposure and to conduct interviews with them for information like the drinking water source. A total of 33,882 North Korean escapees have entered South Korea by December 2022.⁶¹ Among them, 881 had lived in the 8 cities and counties (Kilju County, Hwadae County, Kimchaek City, Myonggan County, Myongchon County, Orang County, Tanchon City and Paegam County) of 3 provinces (North Hamgyong Province, South Hamgyong Province and Ryanggang Province) near the Punggye-ri nuclear test site after North Korea's first nuclear test in 2006 and before their escape from North Korea and arrival in South Korea. Provided that there is a political will, it is not difficult for the South Korean government to conduct a radiation exposure test for them. Other North Korean escapees may also provide more direct or indirect information about the various situations before and after the 6 nuclear tests in relation to the possibility of nuclear leakage.

In fact, in 2017 and 2018, the Ministry of Unification and the Korea Institute of Radiological & Medical Sciences (KIRAMS) conducted radiation exposure tests for the North Korean escapees from the areas near the Punggye-ri nuclear test site. Those who got tested were 30 in 2017 and 10 in 2018 for a total of just 40. Moreover, 4 of those in 2017 and 5 of those in 2018 for a total of 9 (22.5 percent) had test results revealing worrying levels of chromosomal abnormalities, but the Ministry of Unification was lukewarm about publicizing the findings

⁶¹ South Korea's Ministry of Unification, "Policy on North Korean Defectors", https://unikorea.go.kr/eng_unikorea/relations/statistics/defectors/.

and follow-up tests also ceased inexplicably without resumption as of February 2023.

The South Korean government's initiation of radiation exposure tests in 2017

It was a private research organization led by North Korean escapees, not the South Korean government, who first began an academic investigation into the risk of radiation leakage from the Punggye-ri nuclear test site and conducted radiation exposure tests for the North Korean escapees from Kilju County. In 2016, Dr. Choi Kyong-Hui, the first North Korean escapee to receive a doctorate degree from the University of Tokyo and founder of the South and North Development Institute (SAND Institute), was researching the workings of markets in North Korea. During Dr. Choi's interviews, the escapees from Kilju County complained of health problems which led her to conduct in-depth interviews in July 2016 with 13 escapees who had resided in Kilju County for some years following North Korea's 1st to 3rd nuclear tests. In August 2016, Dr. Choi alerted the media that the North Korean escapees from Kilju County were complaining of physical abnormalities such as headaches, weight loss and decreased sensory function, as shown in <Table 3>.

The South and North Development Institute (SAND Institute) presented its findings one month prior to North Korea's 5th nuclear test in September 2016. As a regular briefing, the spokesperson for the Ministry of Unification answered in response to a question from a reporter that "The research of the Kilju County-related North Korean escapees is deemed to have considerable credibility" and that "there will continue to be follow-up investigative activities".⁶² In the National Assembly, Minister of Unification Hong Yong-pyo expressed concern and replied that "I think a more thorough investigation will be needed and we are reviewing the related matters."⁶³

⁶² Kim Hwan Yong, "한국 정부, 북한 핵실험장 인근 탈북자 신체 이상 조사 검토 [South Korean government considers checking for chromosome abnormalities among North Korean defectors who lived near nuclear test sites]", *Voice of America*, September 12, 2016, <https://www.voakorea.com/a/3503530.html>.

⁶³ "2016년도 국정감사 외교통일위원회 회의록 [2016 parliamentary inspection of the National Assembly of the Republic of Korea Foreign Affairs & Unification Committee minutes]" (meeting, Seoul, September 27, 2016), p.57.

Table 3 The physical anomalies experienced by the North Korean escapees from Kilju County (SAND Institute, 2016)

Subjects	Nuclear tests experienced while residing in Kilju County	Symptoms of anomalies
A	1st – 3rd tests	Since 2013, even when I stand still, my body sweats and I lose strength no matter how well I eat and I went to hospital but they could not make a diagnosis. Because I was sick for no reason, people whispered that I caught sangmun, ⁶⁴ that I have a ghost disease.
B	1st – 3rd tests	Around May 2013, I suddenly lost my sense of smell. Around the same time, I lost my sense of taste and my head became cloudy. There was something wrong with my body. Even after coming to South Korea, my sense of smell did not come back. My head still hurts. There are many people around me who have indigestion and are diagnosed with stomach cancer.
C	1st & 2nd tests	Since around 2010, my eyesight dropped from 1.5 to 0.8 and I always felt very tired and suffered from insomnia. I could not walk properly because my legs lack strength and the hind side of my legs become stiff when I am standing. My heart ached so much that I felt like tearing it apart. When I went to hospital in Kilju, I was diagnosed with a rare disease. I had been in prison after being caught in China and repatriated to North Korea, but I was hardly alone and yet I have been afflicted with a strange disease even though I am in my early 40s.

* Nuclear tests: 1st (October 2006), 2nd (May 2009), 3rd (February 2013).

After the initial presentation, SAND institute interviewed 10 additional North Korean escapees from Kilju County making for a total of 23 interviews and referred 5 of them to the Korea Institute of Radiological & Medical Sciences (KIRAMS) to be tested for radiation exposure. In November 2016, after receiving the test results that indicated severe chromosomal abnormalities, Dr. Choi held a press conference urging the South Korean government to launch an official investigation.

Even after the inauguration of President Moon Jae-in in May 2017, the criticism of North Korea prevailed because of its 6th nuclear test in September. As concerns about leakage and dissemination of radiation through ground collapse and groundwater were raised, the government’s testing of the escapees for radiation exposure gained support. At the National Assembly’s inspection of state administration, Minister of Unification Cho Myung-gyon responded

⁶⁴ When someone suddenly falls ill with an unknown disease or dies after coming back from a funeral or visiting a deceased’s home, it is said ‘상문살이 껴다’. Traditionally, many Koreans believed that the spirit of the dead possessed the mourners’ body or followed them to their homes, bringing bad luck.

in writing that “There is a possibility that due to the contamination of groundwater and soil nearby from the radioactive leakage arising from North Korea’s nuclear tests, the population nearby are exposed to radiation” and that “we plan to conduct health checkups including the radiation exposure for the North Korean escapees from Kilju County who so wish”.⁶⁵

In late October 2017, the South Korean government launched the first test on the North Korean escapees from Kilju County from the government level.

Watering down of the 2017 test results and the cover-up of the scaled-down 2018 additional test results

The Ministry of Unification commissioned the Korea Institute of Radiological & Medical Sciences (KIRAMS) to examine 30 North Korean escapees from Kilju County for two months from late October to early December 2017. The test results which were scheduled to be announced on December 27, 2017 were presented in an informal oral briefing by the Director-General of the Humanitarian Cooperation Bureau.⁶⁶ The Ministry of Unification only gave a verbal explanation without providing separate documents and did not post the findings on the website. At the time, foreign journalists from the US, Japan and other countries were excluded from the informal paperless briefing and the South Korean media reported that the Ministry of Unification stated that “Although radiation exposure for some North Korean escapees from Kilju County could be suspected from the tests this time, the time and cause could not be conclusively stated due to confounding variables [such as the age and smoking history]” although with a few caveats.⁶⁷ Afterwards, the National Assembly and the public’s interest faded.

Prior to the Ministry of Unification’s informal paperless briefing, major news

⁶⁵ “2017년도 국정감사 외교통일위원회 회의록 (부록) [2017 parliamentary inspection of the National Assembly of the Republic of Korea Foreign Affairs & Unification Committee minutes (Appendix)]” (meeting, Seoul, October 13, 2017), pp.214-215.

⁶⁶ South Korea’s Ministry of Unification, “Ministry of Unification regular briefing: December 27, 2017”, *UniTV*, 02:58-03:49, <https://unitv.unikorea.go.kr/unitv/web/vod/view.do?id=4331&aid=19&page=47>.

⁶⁷ Paek Nari, “통일부 ‘길주군 탈북민 일부 피폭 의심… 핵실험 영향 단정 못해’ [Ministry of Unification reports they ‘cannot conclude radioactive abnormalities in some North Korean defectors from Kilju are caused by nuclear tests’]”, *Yonhap News Agency*, December 27, 2017, <https://www.yna.co.kr/view/AKR20171227058800014>.

outlets in the US and Japan have been reporting stories of the North Korean escapees who had lived in the Kilju County area or whose families and relatives were living in the area. While taking note of the statements from the North Korean escapees about deaths, tooth loss and birth defects without cause or leukemia and other cancers as well as the rumor of a “ghost disease”, these reports stated that there is insufficient evidence to prove causality with the nuclear tests and that the experts could not speak definitively either.⁶⁸ It was also noted that Kim Jong-il and Kim Jong-un have never inspected the vicinity of the nuclear test site since the start of the nuclear tests.⁶⁹

From September to December 2018, the Ministry of Unification referred 10 additional North Korean escapees from Kilju County to the Korea Institute of Radiological & Medical Sciences (KIRAMS) for examination but failed to present the test results for months. When asked by lawmaker Choung Byoung-gug’s office to submit the results of the radiation exposure tests on the North Korean escapees by year at TJWG’s request before the inspection of state administration in autumn of 2019, the Ministry of Unification-affiliated North Korean Escapees Support Foundation (also called “Korea Hana Foundation”) submitted a 5-page report each for the 2017 and 2018 test results. It had taken 2 years for the 2017 test results and 9 months for the 2018 test results to be reported to a member of the Foreign Affairs and Unification Committee, the responsible standing committee, in the National Assembly. Still, the Ministry of Unification categorically denied the media accusations of a cover-up of the test results and ongoing cover-up of detailed contents.⁷⁰

However, the Ministry of Unification could not explain why it held an informal briefing for the South Korean, cursory as it was, in December 2017 about the test results for 30 people conducted in the second half of 2017 but failed to

⁶⁸ Bruce Harrison, “North Korean defectors say nuclear tests have ravaged their health”, *NBC*, December 3, 2017, <https://www.nbcnews.com/news/north-korea/north-korean-defectors-say-nuclear-tests-have-ravaged-their-health-n824521>.

⁶⁹ Mainichi Japan, “N. Korean defectors express concerns about ‘ghost disease’ back home”, *The Mainichi Shimbun*, January 9, 2018, <https://mainichi.jp/english/articles/20180109/p2a/00m/0na/011000c>.

⁷⁰ South Korea’s Ministry of Unification, “탈북민 방사선 피폭검사 관련 보도에 대한 통일부 입장: TV조선 10.1자 보도(이태희 기자), 조선일보 10.2자 보도(김명성, 김경화 기자)에 대한 설명 [Ministry of Unification’s Position on Media Coverage of Radiation Exposure Tests on North Korean Defectors]”, October 2, 2019, https://www.unikorea.go.kr/unikorea/news/release/?boardId=bbs_000000000000004&mode=view&cntId=54640&category=&pageldx=1.

have any media briefing about the test results for the additional 10 people conducted in the second half of 2018. Allegations have been raised that the 2018 test results were deliberately kept in the dark because around this time the dialogue mood with North Korea was in full swing from the inter-Korean summit at Panmunjom in April 2018 to the US-DPRK summit at Hanoi in February 2019. TJWG was able to confirm that the KIRAMS prepared a report on the test results for 2018 on November 30 that year and submitted it to the North Korean Escapees Support Foundation but that the Ministry of Unification failed to present the findings.

While collecting information in preparation of the present report, TJWG was also able to confirm that the number of additional people tested in 2018 was half the original plan. The North Korean Escapees Support Foundation contracted with the KIRAMS to test up to 20 people in 2018 but only 10 were actually tested.

The test results for 2017 and 2018 submitted to the National Assembly

At lawmaker Choung Byoung-gug's request, the Ministry of Unification-affiliated North Korean Escapees Support Foundation reported that 4 of the 30 North Korean escapees (13.3 percent) tested in October-December 2017 showed median doses above the minimum detection limit, as shown in <Table 4>.

For these 4 North Korean escapees, 7 to 10 stable chromosomal abnormalities and doses of 394 mGy, 320 mGy, 320 mGy, and 279 mGy were detected.

5 of the 10 North Korean escapees (50 percent) additionally tested in September-December 2018 reportedly showed median doses above the minimum detection limit, as shown in <Table 5>. For these 5 North Korean escapees, 7 to 59 stable chromosomal abnormalities and doses of 394 mGy, 320 mGy, 320 mGy, and 279 mGy were detected. Suspicions arose that the test results were suppressed because of the political consideration that the disclosure of the test results exhibiting abnormalities among half of the additional test subjects in 2018 would cause media and public anxiety as well as a backlash from North Korea.

Table 4 Four test subjects with abnormalities in the tests administered by the Korea Institute of Radiological & Medical Sciences (KIRAMS) on 30 North Korean escapees in 2017

< Information on test subjects whose median doses were reported to be greater than the minimum detection limit in stable chromosome abnormality analysis test >					
Subject	Sex/ Age	Stable chromosomal abnormality analysis test	Unstable chromo- somal abnormality analysis test	History of escape from North Korea	History of medical radiation exposures and personal history
		Number of abnormal chromosomes (median dose, 95% confidence interval, unit Gy)	Number of abnor- mal chromosomes (median dose, unit Gy)		
1st test subject	M/43	10 (0.394, 0.149~0.719)	2 (<0.1)	Escaped North Korea in June 2011 Passed by China, Thai- land and Laos Entered South Korea in August 2011 (farmer in Punggye-ri at the time of 1st and 2nd nuclear tests)	Chest X-ray every two years (4 times in total) Former smoker: 4 pack- years (quit 4 years ago) No work experience in handling harmful chemi- cals (pesticides, etc.)
2nd test subject	M/74	8 (0.320, 0.053~0.645)	4 (<0.1)	Escaped North Korea in January 2010 Passed by China, Viet- nam and Cambodia Entered South Korea in December 2010 (office worker in Kilju County at the time of 1st and 2nd nuclear tests)	1 head and neck CT in 2015 1 chest X-ray and 1 head X-ray in 2015 Current smoker: 30 pack-years
3rd test subject	M/53	8 (0.320, 0~1.073)	2 (<0.1)	Escaped North Korea on September 25, 2010 Passed by China Entered South Korea on November 5, 2010 (laborer in Kilju Town at the time of 1 st and 2 nd nuclear tests)	1 chest X-ray in 2010 Current smoker: 30 pack-years
4th test subject	F/39	7 (0.279, 0~1.037)	1 (<0.1)	Escaped North Korea in June 2012 Passed by China (4 years and 6 months) Entered South Korea in March 2017 (Unemployed in Kilju County at the time of 1st and 2nd nuclear tests)	1 chest X-ray in 2017 Nonsmoker

Table 5 Five test subjects with abnormalities in the tests administered by the Korea Institute of Radiological & Medical Sciences (KIRAMS) on 10 North Korean escapees in 2018

<Information on test subjects whose median doses were reported to be greater than the minimum detection limit in stable chromosome abnormality analysis test>								
Sub- ject	Age	Sex	Residence and occupation at the time of nuclear tests	History of medical radiation exposures (type/year)	Stable chromosomal abnormality analysis			
					Number of chromosomal abnormalities observed	Median (Gy)	95% confidence interval	
							Lowest (Gy)	Highest (Gy)
1	45	F	1st: Ryongchon-ri, Orang County / Collective farmer 2nd: Ryongchon-ri, Orang County / Collective farmer 3rd: Longcheng Town, Helong City, China / Processor 4th: Jeongeori, Hoeryong City / Kyohwaso (ordinary prison camp) 5th: Ryongchon-ri, Orang County / Unemployed	CT (2017)	7	0.279	0	0.989
2	26	F	1st: Myongchon County, North Hamgyong Province / Student 2nd: Myongchon County, North Hamgyong Province / Student 3rd: Potonggang District, Pyongyang City / Soldier 4th: Potonggang District, Pyongyang City / Soldier 5th: Potonggang District, Pyongyang City / Soldier 6th: Myongchon County, North Hamgyong Province / Hairdresser	CT (2017)	10	0.394	0.014	1.050
3	63	F	1st: Moksong-ri, Kilju County, North Hamgyong Province / Farmer 2nd: Moksong-ri, Kilju County, North Hamgyong Province / Farmer	CT (2014)	10	0.394	0	1.140
4	48	F	1st: Kilju Town, Kilju County, North Hamgyong Province / Supporting family 2nd: Kilju Town, Kilju County, North Hamgyong Province / Supporting family 3rd: Kilju Town, Kilju County, North Hamgyong Province / Supporting family	CT (2017) PET (2018) Radiation therapy (2017)	59	1.386	0.843	2.009
5	60	M	1st: Kilju Town, Kilju County, North Hamgyong Province/ TV broadcast mechanic 2nd: Kilju Town, Kilju County, North Hamgyong Province/ TV broadcast mechanic 3rd: Chongam-ri, Kilju County, North Hamgyong Province / Forest supervisor	CT (2017)	13	0.493	0.037	1.161

Converting mGy (milligray), the unit of absorbed radiation, into radiation dose to human tissues can be done by simply replacing it with mSv (millisievert). In summary, for the 9 test subjects in 2017 and 2018, the number of chromosomal abnormalities ranged from 7 to 59 and the dose ranged from 279 mSv to 1,386 mSv.

The North Korean escapee with 59 chromosomal abnormalities and dose of 1,386 mSv in particular received much attention. Professor William Barretta, a nuclear physicist at the Massachusetts Institute of Technology (MIT), said in an interview with Voice of America (VOA) that the test results were “extremely high”. He explained that the level of radiation exposure for the North Korean escapees was hundreds of times higher than that of average persons and expressed concern that 1.3Sv (Sievert) or 1,300 mSv (millisievert) from a woman in her late 40s “would cause serious radiation sickness”.⁷¹ Professor Joo Hanyu of the Department of Nuclear Engineering at Seoul National University stated that “In the case of the Fukushima region, the average radiation level was about 1mSv, and when the radiation accident occurred, the field workers’ [exposure doses] were less than 100mSv” and that “The test results for the North Korean escapees showed a staggering level that are hundreds of times higher than that of average persons, the numbers that could not show up unless exposed to radiation”.⁷²

However, the Ministry of Unification and other government ministries and affiliated organs were busy downplaying the significance of these numbers. Although inquiries and calls for follow-up measures from the relevant standing

71 William Kim, “미 핵물리학 전문가 ‘풍계리 주민에게서 나온 피폭 수치 극도로 높아’ [A U.S. nuclear physicist says ‘extremely high radiation levels found in Punggye-ri residents’]”, *Voice of America*, October 3, 2019, <https://www.voakorea.com/a/5108101.html>; While the Ministry of Unification dismissed domestic news reports as false coverage, it did not take any official position regarding foreign media reports. Kim Yeon-chul, the second Minister of Unification under President Moon Jae-in, claimed that Chosun Ilbo (October 2, 2019) and TV Chosun (October 1, 2019)’s reports of dangerous level of radiation detected in North Korean defectors from Punggye-ri are major examples of fake news. On October 2, the Ministry of Unification announced a press release. TV Chosun requested that the Ministry of Unification makes revisions (October 7) and corrections (October 15), to which the Ministry did only to a certain degree. Lee In-young, the third Minister of Unification under the Moon administration, also took the same position as his predecessor. He also claimed that the news were fake in his written response to the materials requested at his confirmation hearing in July 2020.

72 Kim MyungSung and Kim Kyeong-Hwa, “풍계리 출신 탈북민 몸에서 치사량 수준 방사능 검출 [Lethal level of radiation detected in North Korean defectors from Punggye-ri]”, *The Chosun Ilbo*, October 2, 2019, https://www.chosun.com/site/data/html_dir/2019/10/02/2019100200141.html.

committees of the National Assembly continued, the Ministry of Unification stonewalled maintaining that it is difficult to find a link to the nuclear tests in the test results for 2017 and 2018. According to the Ministry of Unification's response to the National Assembly, "Although numbers indicating radiation exposure were drawn to a certain extent from some of the 40 test subjects, in consideration of various confounding variables such as the test subjects' age, history of medical radiation exposures (CT/PET/radiation treatment experience), smoking history and exposure to harmful chemicals that could not be excluded, it is the determination of an expert at the Korea Institute of Radiological & Medical Sciences (KIRAMS) that it is not possible to specify which factor was the cause".⁷³ However, the Ministry of Unification failed to disclose the name or title of "an expert at the Korea Institute of Radiological & Medical Sciences (KIRAMS)" who gave such a determination. Moreover, regarding the highest dose of 1,386 mSv, in response to a question about the likelihood of doses exceeding 100mSv for average persons from CT or X-rays in light of the Nuclear Safety Act's annual upper limit of 1mSv for average persons and 50mSv for those in the relevant industries, Dr. Kim Mi-sook, president of the Korea Institute of Radiological & Medical Sciences (KIRAMS), stated that it should not come up to be 100mSv.⁷⁴

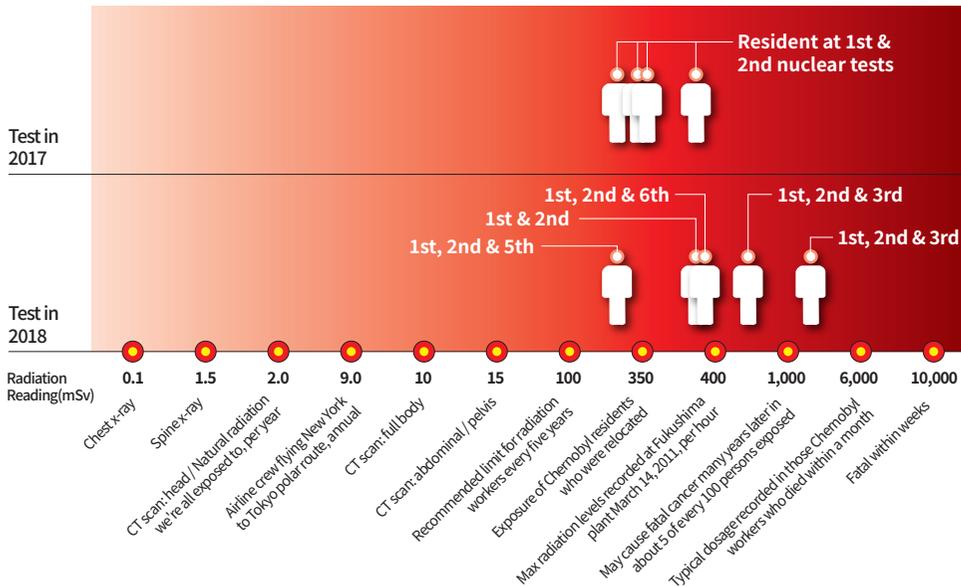
Radiation dose standards and exposure risks commonly used in the international community indicate that from above 1,000 mSv (= 1 Sv) there is a risk of causing cancer, vomiting and leukocyte reduction and that death may be caused at a higher interval.

<Figure 2> shows the placement of the 9 North Korean escapees by exposure dose (mSv) intervals and the nuclear test times periods that they personally experienced.

73 A written response from Settlement Support Division, Humanitarian Cooperation Bureau under the Ministry of Unification; "2019년도 국정감사 외교통일위원회 회의록 (부록) [2019 parliamentary inspection of the National Assembly of the Republic of Korea Foreign Affairs & Unification Committee minutes (Appendix)]" (meeting, Seoul, October 21, 2019), p.105.

74 Asked by Assemblyman Park Sungjoong ("2019년도 국정감사 과학기술정보방송통신위원회 회의록 [2019 parliamentary inspection of the National Assembly of the Republic of Korea Science, ICT, Broadcasting, and Communications Committee minutes]" (meeting, Seoul, October 10, 2019), p.94).

Figure 2 The comparison of exposure risk of the 9 persons with abnormalities in the 2017 and 2018 tests



Sources: UN Scientific Committee on the Effects of Atomic Radiation(UNSCEAR), International Commission on Radiological Protection(ICRP) and The Guardian

The North Korean escapees who had been in Kilju County up to the 3rd to 6th nuclear tests tend to have more chromosomal abnormalities and higher radiation doses than those who had been in Kilju County up to only the 1st to 2nd nuclear tests. This suggests that the South Korean government needs to actively contact the North Korean escapees who experienced the 3rd to 6th nuclear tests period in North Korea and expand the scale of radiation exposure tests.

In the informal oral briefing on the test results in 2017, the Ministry of Unification stated that no North Korean escapee from Kilju County had entered South Korea after the 4th nuclear test and that additional tests will be administered taking into consideration the timing of escape from North Korea.⁷⁵ However, as shown in <Table 5>, one person who escaped from

⁷⁵ Paek Nari, “통일부 ‘길주군 탈북민 일부 피폭 의심… 핵실험 영향 단정 못해’ [Ministry of Unification reports they ‘cannot conclude radioactive abnormalities in some North Korean defectors from Kilju are caused by nuclear tests’]”, *Yonhap News Agency*, December 27, 2017, <https://www.yna.co.kr/view/AKR20171227058800014>.

Myongchon County after the 6th nuclear test in 2017 can be identified, but TJWG was able to confirm that no person who escaped from Kilju after the 6th nuclear test in 2017 was among the five other test subjects not mentioned in <Table 5>.

Since the 2017 and 2018 test results tables submitted to the National Assembly by the North Korean Escapees Support Foundation differ in format and item composition which makes the comparison difficult, TJWG combined the two tables (<Table 6>).

There are three differences between the 2017 and 2018 test result tables. First, in the 2017 table contains both the stable chromosome and unstable chromosome test results, but the 2018 table does not have the unstable chromosome test results. It appears that either the unstable chromosome tests were not conducted in 2018 or the test results were not disclosed.

Second, the 2017 table discloses the year of last escape from North Korea and the year of entry into South Korea while the 2018 table discloses neither. It is possible that if unstable chromosome tests had not been administered on the recent escapees, the year of last escape from North Korea may not have been disclosed to prevent anyone raising questions about this. The Ministry of Unification has explained that the unstable chromosome test is a method to check the radiation exposure within the past three months.⁷⁶

Third, the 2017 table specifies smoking history and experience in handling harmful chemicals, but the 2018 table does not. The Ministry of Unification claimed that those who displayed signs of radiation exposure in the 2018 tests too may have been affected by harmful substances such as smoking, but the 2018 table provides no basis for this.

⁷⁶ South Korea's Ministry of Unification, "탈북민 방사선 피폭검사 관련 보도에 대한 통일부 입장 [Ministry of Unification's Position on Media Coverage of Radiation Exposure Tests on North Korean Defectors]", October 17, 2019, https://www.unikorea.go.kr/unikorea/news/release/?boardId=bbs_0000000000000004&mode=view&cntId=54645&category=&pageIdx=8.

Table 6 The combined table of the 9 North Korean escapees with abnormalities in the 2017 and 2018 tests

Year of testing	Subject	Sex / Age	Stable chromosome				Unstable chromosome	Residence at the time of each nuclear test (year) / Occupation	Year of last escape from North Korea	History of medical radiation exposures (type / year)	Personal history
			Number of abnormal chromosomes	Median (Gy)	95% confidence interval						
					Lowest (Gy)	Highest (Gy)					
2017	1	M 43	10	394	149	719	2	1st(2006) Punggye-ri / Farmer 2nd (2009) Punggye-ri / Farmer	2011	Chest X-ray every two years (Every two years; 4 times in total)	Former smoker (4 pack-years; quit 4 years ago) No work experience in handling harmful chemicals (pesticides, etc.)
	2	M 74	8	320	53	645	4	1st(2006) Kilju County / Office worker 2nd(2009) Kilju County / Office worker	2010	1 head and neck CT in 2015 1 chest X-ray and 1 head X-ray in 2015	Current smoker (30 pack-years)
	3	M 53	8	320	0	1073	2	1st(2006) Kilju Town, Kilju County / Laborer 2nd (2009) Kilju Town, Kilju County / Laborer	2010	1 chest X-ray (2010)	Current smoker (30 pack-years)
	4	F 39	7	279	0	1037	1	1st(2006) Kilju County / Unemployed 2nd(2009) Kilju County / Unemployed	2012	1 chest X-ray (2017)	Nonsmoker

2018	1	F 45	7	279	0	989	1st (2006) Ryongchon-ri, Orang County / Collective farmer 2nd (2009) Ryongchon-ri, Orang County / Collective farmer 5th (2016) Ryongchon-ri, Orang County / Unemployed	CT (2017)	
	2	F 26	10	394	14	1050	1st (2006) Myongchon County / Student 2nd (2009) Myongchon County / Student 6th (2017) Myongchon County / Hair- dresser	CT (2017)	
	3	F 63	10	394	0	1140	1st (2006) Moksong-ri, Kilju County / Farmer 2nd (2009) Moksong-ri, Kilju County / Farmer	CT (2014)	
	4	F 48	59	1386	843	2009	1st (2006) Kilju Town, Kilju County / Supporting family 2nd (2009) Kilju Town, Kilju County / Supporting family 3rd (2013) Kilju Town, Kilju County / Supporting family	CT (2017) Radiation therapy (2017) PET (2018)	

2018	5	M 60	13	493	37	1161	1st (2006) Kilju Town, Kilju County / TV broadcast mechanic			
							2nd (2009) Kilju Town, Kilju County / TV broadcast mechanic		CT (2017)	
							3rd (2013) Chongam-ri, Kilju County / Forest supervi- sor			

Information missing in the 2018 table

The suspicion that the Ministry of Unification and Ministry of Unification-affiliated North Korean Escapees Support Foundation have been restricting the access to the test results as classified information has also been confirmed as a fact. In the National Assembly, Dr. Uhm Jae-sik, the chairperson of the Nuclear Safety And Security Commission, stated that although the Ministry of Unification commissioned the Korea Institute of Radiological & Medical Sciences (KIRAMS) to conduct radiation exposure tests for the North Korean escapees, his Commission was neither notified nor given the materials. A lawmaker publicly complained that he had asked Dr. Jin Young-woo, the Director General of the National Radiation Emergency Medical Center (NREMC) at the Korea Institute of Radiological & Medical Sciences (KIRAMS), for information. They were told by Dr. Jin that “Even if the National Assembly requests the information, I cannot submit it without permission. It has been decided that the Ministry of Information and the Hana Foundation will have full authority over the tests. It cannot be used even for research papers” and lambasted that “As a result, the South Korean people and the international community is kept in the dark”.⁷⁷ In response to an inquiry from the National Assembly about the use of the radiation exposure test results by the government

⁷⁷ “2019년도 국정감사 과학기술정보방송통신위원회 회의록 [2019 parliamentary inspection of the National Assembly of the Republic of Korea Science, ICT, Broadcasting, and Communications Committee minutes]” (meeting, Seoul, October 7, 2019), p.57.

ministries, the Ministry of Unification replied in writing that “The relevant ministries have not been utilized by the relevant ministries, and there are currently no plans to conduct research for academic purposes”.⁷⁸

It is also problematic that the North Korean escapees have not had a detailed explanation about the test results and that no follow-up tests have been conducted for the 9 North Korean escapees whose chromosomal abnormalities have been identified. A female North Korean escapee in her 70s who had lived in Kilju Town, Kilju County until 2013 stated that she was not once contacted by the Ministry of Unification before, during or after the South Korean government’s radiation exposure test and that the Korea Institute of Radiological & Medical Sciences (KIRAMS) did not even explain the test results to her. There was no guidance from the government officials; instead, Dr. Choi Kyong-Hui of the South and North Development Institute (SAND Institute), a private organization, explained the purpose of the test, accompanied her on the test date and explained to her how to visit the Korea Institute of Radiological & Medical Sciences (KIRAMS) and have the test result paper issued at the counter because it was not delivered home.⁷⁹

The South Korean government’s cessation of the tests since 2019

In the fall of 2019, the lawmakers criticized the absence of any follow-up measures from the government despite the test results revealing worrying levels of chromosomal abnormalities in the radiation exposure tests for a small number of North Korean escapees. In particular, there was an urgent call for testing all North Korean escapees from the areas near the Punggye-ri test site, especially those who had escaped from these areas after North Korea’s 6th nuclear test in 2017.

The lawmakers also said that the necessary budget for the additional tests can be provided as long as the Korea Institute of Radiological & Medical Sciences

⁷⁸ “2019년도 국정감사 외교통일위원회 회의록 (부록) [2019 parliamentary inspection of the National Assembly of the Republic of Korea Foreign Affairs & Unification Committee minutes (Appendix)]” (meeting, October 21, 2019), p.106.

⁷⁹ Interview with a North Korean escapee, interview by Transitional Justice Working Group, Seoul, January 10, 2023,

(KIRAMS) and the Ministry of Unification submitted a plan. On October 10, 2019, Dr. Kim Mi-sook, president of the Korea Institute of Radiological & Medical Sciences (KIRAMS), stated at the National Assembly Science, ICT, Broadcasting and Communication Committee that “We are ready to do it if the Ministry of Unification asks”.⁸⁰ In late October 2019, at the National Assembly Foreign Affairs and Unification Committee, Unification Minister Kim Yeon-chul stated that he “will do so” when a lawmaker demanded increasing the budget by about 280 million won (220,000 US dollars) to provide radiation exposure tests for all 187 then-known North Korean escapees from Kilju County as each test was known to cost 1.5 million won.⁸¹

However, there were no budget increases; in fact, the radiation exposure tests for the North Korean escapees ceased completely since 2019. At the National Assembly Foreign Affairs and Unification Committee’s inspection of state administration in October 2020, the need for testing all North Korean escapees from the areas near the Punggye-ri nuclear test site was raised with the Ministry of Unification again to which Minister of Unification Lee In-young stated that “We have been operating with enough care so that those who want the radiation exposure test can receive it” and that “This year ... it is a fact that there was very little demand practically due to COVID-19 so we will review the matter in light of the situation next year”.⁸² However, the Ministry of Unification failed to resume the tests in 2021 and 2022.

Estimation of the number of North Korean escapees in South Korea that can be tested and the cost of testing all of them

How many North Korean escapees from Kilju County and other areas nearby are there in South Korea? In 2016, the Ministry of Unification replied to advance questions prior to the National Assembly’s inspection of state

80 “2019년도 국정감사 과학기술정보방송통신위원회 회의록 [2019 parliamentary inspection of the National Assembly of the Republic of Korea Science, ICT, Broadcasting, and Communications Committee minutes]” (meeting, Seoul, October 10, 2019), p.94.

81 “제371회 상임위원회 (정기회) 외교통일위원회 회의록 제5호 (부록) [371th Regular session of the National Assembly of the Republic of Korea Foreign Affairs & Unification Committee minutes no. 5 (Appendix)]” (meeting, Seoul, October 30, 2019), p.13.

82 “2020년도 국정감사 외교통일위원회 회의록 [2020 parliamentary inspection of the National Assembly of the Republic of Korea Foreign Affairs & Unification Committee minutes]” (meeting, Seoul, October 23, 2020), p.43.

administration that there are about 100 North Korean escapees in South Korea who had lived in Kilju County over the past 10 years from 2006 to 2016; the number of North Korean escapees from the areas near the Punggye-ri test site other than Kilju County was not provided.⁸³ In response to the questions following the inspection of state administration in 2019, the Ministry of Unification stated that there were 187 North Korean escapees from Kilju County for the past 9 years from 2010 to 2019, but again the number of North Korean escapees from the areas other than Kilju County was not provided.⁸⁴

In July 2020, at TJWG's request, lawmaker Tae Yong-ho's office asked the Ministry of Unification for the number of North Korean escapees in South Korea from the areas near the Punggye-ri nuclear test site. According to the Ministry of Unification, among the North Korean escapees who entered South Korea in 2006-2020, there were 301 who had resided in Kilju County and the number increased to 1,673 if other areas nearby were also included.⁸⁵ However, since the figures provided by the Ministry of Unification were based on the year of entry into South Korea, it was not possible to determine the numbers based on the time of residence in the areas near the Punggye-ri nuclear test site. For instance, the reported figures could include the North Korean escapees who years before the 1st nuclear test in 2006 had moved to a different area within North Korea and then escaped from the country or had escaped to China and were in hiding for many years there before entering South Korea at some point after 2006.

On February 7, 2023, two weeks before the publication of the present report, TJWG obtained the latest statistics compiled by the Ministry of Unification with the help of an aid from a member of the National Assembly. <Table 7> shows the current status of the North Korean escapees in South Korea who

83 "2016년도 국정감사 외교통일위원회 회의록 (부록) [2016 parliamentary inspection of the National Assembly of the Republic of Korea Foreign Affairs & Unification Committee minutes (Appendix)]" (meeting, Seoul, October 14, 2016), p.54.

84 "제371회 상임위원회(정기회) 외교통일위원회 회의록 제5호 (부록) [371th Regular session of the National Assembly of the Republic of Korea Foreign Affairs & Unification Committee minutes no. 5 (Appendix)]" (meeting, Seoul, October 30, 2019), p.13.

85 "제382회 상임위원회(정기회) 국회 외교통일위원회 회의록 제4호(부록) [382nd Regular session of the National Assembly of the Republic of Korea Foreign Affairs & Unification Committee minutes no. 4 (Appendix)]" (meeting, Seoul, November 5, 2020), p.543.

had lived in the areas near the Punggye-ri nuclear test site since 2006 when North Korea began its nuclear tests. There are 160 escapees who had resided in Kilju County and 881 escapees who had resided in 8 cities and counties (Kilju County, Hwadae County, Kimchaek City, Myonggan County, Myongchon County, Orang County, Tanchon City and Paegam County) of 3 provinces (North Hamgyong Province, South Hamgyong Province and Ryanggang Province) near the Punggye-ri nuclear test site.

Table 7 The current status of the North Korean escapees in South Korea who had resided in the areas near the Punggye-ri nuclear test site after the 1st nuclear test in 2006 (as of February 2023)

Unit: person

Year of defection	North Hamgyong Province						South Hamgyong Province	Ryanggang Province	Total
	Kilju County	Hwadae County	Kimchaek City	Myonggan County (formerly Hwasong County)	Myongchon County	Orang County	Tanchon City	Paegam County	
2006	19	3	18	10	8	17	34	18	127
2007	16	7	19	18	6	4	27	12	109
2008	18	1	18	12	6	4	19	19	97
2009	11	1	27	3	4	4	20	24	94
2010	19	3	13	5	2	1	21	30	94
2011	21	2	22	3	7	4	25	38	122
2012	11	1	16	7	6	2	6	21	70
2013	20	-	8	1	3	1	15	12	60
2014	19	-	6	4	-	1	3	16	49
2015	2	1	4	3	3	-	1	2	16
2016	-	-	2	-	1	2	3	8	16
2017	1	-	3	1	2	-	-	1	8
2018	-	1	2	1	1	-	2	2	9
2019	3	-	3	-	1	1	2	-	10
2020	-	-	-	-	-	-	-	-	-
2021	-	-	-	-	-	-	-	-	-
2022	-	-	-	-	-	-	-	-	-
Total	160	20	161	68	50	41	178	203	881

<Table 8> shows the current status of the North Korean escapees in South Korea who had resided in the areas near the Punggye-ri nuclear test site after the 6th nuclear test in 2017. There are 3 from Kilju County and 20 from all areas near the Punggye-ri nuclear test (8 cities and counties).

Table 8 The current status of the North Korean escapees in South Korea who had resided in the areas near the Punggye-ri nuclear test site after the 6th nuclear test in 2017 (as of February 2023)

Unit: person

Year of defection	North Hamgyong Province						South Hamgyong Province	Ryanggang Province	Total
	Kilju County	Hwadae County	Kimchaek City	Myonggan County (formerly Hwasong County)	Myongchon County	Orang County	Tanchon City	Paegam County	
After Sept. 2017	-	-	-	-	1	-	-	-	1
2018	-	1	2	1	1	-	2	2	9
2019	3	-	3	-	1	1	2	-	10
2020	-	-	-	-	-	-	-	-	-
2021	-	-	-	-	-	-	-	-	-
2022	-	-	-	-	-	-	-	-	-
Total	3	1	5	1	3	1	4	2	20

How much budget would be necessary for the South Korean government to expand the radiation exposure tests to the North Korean escapees in South Korea who had resided in the areas near the Punggye-ri nuclear test site after the 1st nuclear test in 2006? The tests commissioned by the Ministry of Unification-affiliated North Korean Escapees Support Foundation and conducted by the Korea Institute of Radiological & Medical Sciences (KIRAMS)⁸⁶ in 2017 and 2018 cost 1,586,000 KRW (approximately 1,300 USD). As shown in <Table 9>, the South Korean government will need 253,760,000 KRW (approximately

⁸⁶ Korea Institute of Radiological & Medical Sciences (KIRAMS) is a public institution under the Ministry of Science and ICT. Established in 1963, is the only radiology research institute in South Korea and has a national atomic energy cancer hospital. This makes it a suitable location to conduct follow-up cancer treatment for tested defectors if needed.

211,000 USD) or 1,397,266,000 KRW (approximately 1,164,000 USD) to test all North Korean escapees in South Korea who had resided in Kilju County or the areas near Punggye-ri nuclear test site (8 cities and counties) since 2006 respectively.

Table 9 The budget necessary to expand the radiation exposure tests to the North Korean escapees in South Korea who had resided in the areas near the Punggye-ri nuclear test site after the 1st nuclear test in 2006

₩1,200 KRW (Korean Won) = \$1 USD

North Korean escapees	Number of persons	Necessary budget	Calculation
Those who had resided in Kilju County after 2006	160	₩253,760,000 KRW (\$211,000 USD)	₩1,586,000 KRW x 160 persons = ₩253,760,000 KRW
Those who had resided in the areas near Punggye-ri (8 cities and counties)	881	₩1,397,266,000 KRW (\$1,164,000 USD)	₩1,586,000 KRW x 881 persons = ₩1,397,266,000 KRW

South Korea can fully bear these costs; what is needed is the political will of the South Korean government under President Yoon Seok-yeol.

RECOMMENDATIONS

The risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site in North Korea threatens the right to life and health of not only the hundreds of thousands living in the areas nearby but also the populations in neighboring countries through the smuggling and distribution of agricultural and marine products as well as local specialties.

Considering the seriousness and transboundary nature of the issue, TJWG recommends the following to governments, international organizations and other stakeholders:

To the North Korean government

1. In accordance with the Treaty on the Non-Proliferation of Nuclear Weapons (NPT: Non-Proliferation Treaty) and UN resolutions, cease the nuclear development and nuclear tests, and take steps towards a complete, verifiable and irreversible denuclearization (CVID).
2. Conduct a prompt, effective, thorough, independent and impartial investigation into the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site and disclose the results of the investigation.
3. Inform the people living in the 8 cities and counties (Kilju County, Hwadae County, Kimchaek City, Myonggan County, Myongchon County, Orang County, Tanchon City and Paegam County) near the Punggye-ri nuclear test site about the risk of groundwater contamination from the radioactive materials, provide safe water sources until the risk is resolved, conduct tests for them and explain the test results to them in an accurate and detailed manner, provide in-depth examination and necessary treatment for test

subjects who display abnormal signs or symptoms and, if necessary, seek international assistance.

4. Disclose the test results for agricultural and marine products from the 8 cities and counties (Kilju County, Hwadae County, Kimchaek City, Myonggan County, Myongchon County, Orang County, Tanchon City and Paegam County) near the Punggye-ri nuclear test site and, if they are found to be contaminated, establish a cooperative system with the neighboring governments to prevent their smuggling and distribution at home and abroad.

To the South Korean government

1. Disclose the full reports on the radiation exposure tests conducted for 30 North Korean escapees from Kilju County in 2017 and 10 North Korean escapees from Kilju County in 2018 submitted by the Korea Institute of Radiological & Medical Sciences (KIRAMS) to the Ministry of Unification (MOU) (anonymize if necessary) while the Korea Institute of Radiological & Medical Sciences (KIRAMS) explains the purpose and results of the tests to the 40 North Korean escapees who have been tested in an accurate and detailed manner and provides in-depth examination and necessary treatment for the 9 people with chromosomal abnormalities.
2. Among the North Korean escapees in South Korea, inform all North Korean escapees who had lived in the 8 cities and counties (Kilju County, Hwadae County, Kimchaek City, Myonggan County, Myongchon County, Orang County, Tanchon City and Paegam County) near the Punggye-ri nuclear test site about the risk of radiation exposure, conduct testing for those who are willing and explain the test results to them in an accurate and detailed manner and provide in-depth examination and necessary treatment for the test subjects who display abnormal signs or symptoms.
3. In the additional expanded investigation of the North Korean escapees in South Korea who had lived in the 8 cities and counties (Kilju County, Hwadae County, Kimchaek City, Myonggan County, Myongchon County, Orang County, Tanchon City and Paegam County) near the Punggye-ri nuclear test site, disclose the analysis of chromosomal abnormalities

and radiation dose by the period of residence near Punggye-ri, the area of residence, drinking water source, etc. (anonymize if necessary) and inform the international community.

4. Propose conducting jointly a prompt, effective, thorough, independent and impartial investigation into the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site to the North Korean government and, if the North Korean government rejects or ignores the proposal, propose such an investigation by the UN or IAEA.
5. Urge the North Korean government to inform the people living in the 8 cities and counties (Kilju County, Hwadae County, Kimchaek City, Myonggan County, Myongchon County, Orang County, Tanchon City and Paegam County) near the Punggye-ri nuclear test site about the risk of groundwater contamination from the radioactive materials, provide safe water sources until the risk is resolved, conduct tests for them and explain the test results to them in an accurate and detailed manner, provide in-depth examination and necessary treatment for test subjects who display abnormal signs or symptoms and, if necessary, seek international assistance.
6. Strengthen the suppression and inspection of imported agricultural and marine products as well as local specialties suspected of being produced in North Korea, disclose all inspection results, promote collaboration and joint research with neighboring countries like China and Japan to stop smuggling and distribution of such products from North Korea, and propose to the North Korean government a joint investigation of such products from the areas near the Punggye-ri nuclear test site.
7. Make efforts to insert a call for investigation of the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site, prevention of harm and remedies in bilateral or multilateral statements, resolutions, etc. on North Korean nuclear development or human rights situation.
8. For South Korea's National Human Rights Commission, adopt a public statement expressing concern about the risk of groundwater contamination

from the radioactive materials at the Punggye-ri nuclear test site, urging the South Korean government to take the measures stated above and calling for investigation of the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site, prevention of harm and remedies.

To the Chinese government

1. Disclose the results of radioactive environment surveys conducted by the Chinese government or research institutes in the North Korea-China border area after North Korea's 1st nuclear test in 2006.
2. Propose conducting jointly a prompt, effective, thorough, independent and impartial investigation into the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site to the North Korean government and, if the North Korean government rejects or ignores the proposal, propose such an investigation by the UN or IAEA.
3. Urge the North Korean government to inform the people living in the 8 cities and counties (Kilju County, Hwadae County, Kimchaek City, Myonggan County, Myongchon County, Orang County, Tanchon City and Paegam County) near the Punggye-ri nuclear test site about the risk of groundwater contamination from the radioactive materials, provide safe water sources until the risk is resolved, conduct tests for them and explain the test results to them in an accurate and detailed manner, provide in-depth examination and necessary treatment for test subjects who display abnormal signs or symptoms and, if necessary, seek international assistance.
4. Strengthen the suppression and inspection of imported agricultural and marine products as well as local specialties suspected of being produced in North Korea, disclose all inspection results, promote collaboration and joint research with neighboring countries like South Korea and Japan to stop smuggling and distribution of such products from North Korea, and propose to the North Korean government a joint investigation of such products from the areas near the Punggye-ri nuclear test site.
5. Make efforts to insert a call for investigation of the risk of groundwater

contamination from the radioactive materials at the Punggye-ri nuclear test site, prevention of harm and remedies in bilateral or multilateral statements, resolutions, etc. on North Korean nuclear development or human rights situation.

To the Japanese government

1. Propose conducting jointly a prompt, effective, thorough, independent and impartial investigation into the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site to the North Korean government and, if the North Korean government rejects or ignores the proposal, propose such an investigation by the UN or IAEA.
2. Urge the North Korean government to inform the people living in the 8 cities and counties (Kilju County, Hwadae County, Kimchaek City, Myonggan County, Myongchon County, Orang County, Tanchon City and Paegam County) near the Punggye-ri nuclear test site about the risk of groundwater contamination from the radioactive materials, provide safe water sources until the risk is resolved, conduct tests for them and explain the test results to them in an accurate and detailed manner, provide in-depth examination and necessary treatment for test subjects who display abnormal signs or symptoms and, if necessary, seek international assistance.
3. Strengthen the suppression and inspection of imported agricultural and marine products as well as local specialties suspected of being produced in North Korea, disclose all inspection results, promote collaboration and joint research with neighboring countries like South Korea and China to stop smuggling and distribution of such products from North Korea, and propose to the North Korean government a joint investigation of such products from the areas near the Punggye-ri nuclear test site.
4. Make efforts to insert a call for investigation of the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site, prevention of harm and remedies in bilateral or multilateral statements, resolutions, etc. on North Korean nuclear development or human rights situation.

To other governments and regional bodies like the EU and ASEAN

1. Propose conducting jointly a prompt, effective, thorough, independent and impartial investigation into the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site to the North Korean government and, if the North Korean government rejects or ignores the proposal, propose such an investigation by the UN or IAEA.
2. Make efforts to insert a call for investigation of the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site, prevention of harm and remedies in bilateral or multilateral statements, resolutions, etc. on North Korean nuclear development or human rights situation.
3. In July 2021, UK Parliament's All-Party Parliamentary Group on North Korea (APPG-NK) published an investigative report on North Korea's human rights, which included the reported mobilization of prisoners of a nearby political prison camp (kwanliso) to build the Punggye-ri nuclear test site and emphasized the need for providing radiation exposure test and medical care to the people living nearby.⁸⁷ Similarly, other governments or EU human rights ambassadors, international human rights situation reports, parliamentary resolutions and reports can call for investigation of the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site, prevention of harm and remedies.

To the UN

1. For the UN Security Council and the General Assembly, include a call for investigation of the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site, prevention of harm and remedies in the agenda when discussing North Korean security and human rights

⁸⁷ All-Party Parliamentary Group for North Korea, *Inquiry into Human Rights Violations in North Korea 2014-2020/1* (2021), https://b64a88a3-b1cd-4d11-8279-50610a8df584.filesusr.com/ugd/897883_7740417d3bb04474807a9e9679d6b2ec.pdf.

situation.

2. For the UN Human Rights Council, include a call for investigation of the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site, prevention of harm and remedies in the agenda when discussing North Korean human rights situation.
3. For the UN special procedures mandate holders including the Special Rapporteur on DPRK human rights, the Special Rapporteur on the rights to water and sanitation, the Special Rapporteur on human rights and the environment, the Special Rapporteur on the right to health and the Special Rapporteur on hazardous substances and wastes, individually or collectively call for investigation of the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site, prevention of harm and remedies.
4. At North Korea's fourth-cycle Universal Periodic Review (UPR) at the UN Human Rights Council in October/November 2024, each country must call for investigation of the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site, prevention of harm and remedies.
5. In March 2021, TJWG asked the Human Rights Committee to include in the list of issues (LOI) in relation to North Korea's third periodic report three questions (Have the residents in the vicinity of the Punggye-ri nuclear test site been warned about the possible radioactive contamination of groundwater sources? Have the residents in the vicinity of the Punggye-ri nuclear test site been tested for radiation exposure? Does the DPRK have the capacity to treat radiation-related patients?) and three recommendations (Check for possible radioactive contamination of groundwater sources; Provide the necessary medical care for those suffering from radiation exposure; Seek international assistance for the detection and treatment of radiation exposure). In the end, issue 12 of North Korea's LOI in relation to the right to life included "please describe the steps taken within the reporting period to stop the proliferation of weapons of mass destruction ... Please also discuss the environmental impact of nuclear test sites, including responding to reports that groundwater

sources have become contaminated and have exposed people in affected areas to radiation”.⁸⁸ In addition to the Human Rights Committee (HRC), the Committee on Economic, Social and Cultural Rights (CESCR), the Committee on the Elimination of Discrimination against Women (CEDAW), the Committee on the Rights of the Child (CRC) and the Committee on the Rights of Persons with Disabilities (CRPD) must also call for investigation of the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site, prevention of harm and remedies in their consideration of North Korea’s periodic reports.

To the International Atomic Energy Agency (IAEA)

1. When North Korea signed the Convention on Early Notification of a Nuclear Accident⁸⁹ and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency⁹⁰ on September 29, 1986, it made the declaration that “In view of the urgency of the question of nuclear safety the Democratic People’s Republic of Korea will apply [the Convention] provisionally” with respect to the two treaties. According to article 1 (1) of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, states parties have an obligation to “cooperate between themselves and with [the IAEA] in accordance with the provisions of this Convention to facilitate prompt assistance in the event of a nuclear accident or radiological emergency to minimize its consequences and to protect life, property and the environment from the effects of radioactive releases”. Under articles 1 and 2 of the Convention on Early Notification of a Nuclear Accident, a State Party in the event of a nuclear accident has an obligation to “forthwith notify, directly or through [the IAEA], those States which are or may be physically affected ... and [the IAEA] of the nuclear accident, its nature, the time of its occurrence and its exact location where

⁸⁸ United Nations Human Rights Committee, “List of issues prior to the submission of the third periodic report of the Democratic People’s Republic of Korea,” CCPR/C/PRK/QPR/3, June 22, 2021, <https://undocs.org/CCPR/C/PRK/QPR/3>.

⁸⁹ IAEA, Convention on Early Notification of a Nuclear Accident, <https://www.iaea.org/topics/nuclear-safety-conventions/convention-early-notification-nuclear-accident>.

⁹⁰ IAEA, Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, <https://www.iaea.org/topics/nuclear-safety-conventions/convention-assistance-case-nuclear-accident-or-radiological-emergency>.

appropriate” and “promptly provide [those States], directly or through [the IAEA], and [the IAEA] with available information relevant to minimizing the radiological consequences in those States”. Therefore, the IAEA must urge North Korea to investigate the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site.

Civil society, media, business and ordinary citizens

1. Express interest and concern about the risk of groundwater contamination from the radioactive materials at the Punggye-ri nuclear test site and urge a prompt, effective, thorough, independent and impartial investigation.
2. Urge the governments and international organizations to take the measures stated above.

