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Using Urban Green Spaces in the Pandemic: Example from the Republic of Korea



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ACRONYMS

COVID-19	Coronavirus disease 2019
EbA	Ecosystem-based Adaptation
FEBA	Friends of Ecosystem-based Adaptation
IEA	International Energy Agency
ILO	International Labour Organization
KFS	Korea Forest Service
KNPS	Korea National Park Service
PM2.5	Fine particulate matter
SMG	Seoul Metropolitan Government
UGS	Urban green space(s)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WHO	World Health Organization

EXECUTIVE SUMMARY

The COVID-19 pandemic began in early 2020 and has had an enormous impact on global public health and economic, social and environmental sectors. Faced with the prospect that the effects of this pandemic and climate change will be extensive and long-term, the international community has shown interest in Ecosystem-based Adaptation (EbA) approaches. There seems to be an emergence of methods that focus on approaching and adapting to mega-issues through nature. Specifically, there seems to be an emergence of trends that utilize green spaces and green infrastructure in cities as part of the solutions for various challenges. Based on this context, this paper aims to analyze how urban green space (UGS) has been applied as a response to COVID-19.

This paper defines UGS and identifies different types of UGS; it also outlines the impact of COVID-19 and the need for an EbA approach. Additionally, the paper presents the results of a survey conducted in the Republic of Korea (hereinafter 'Korea'), revealing citizen perceptions of UGS, and how opinions have changed in the COVID-19 context. It also gathers their views on how UGS should be expanded. Furthermore, it looks at the efforts of the Korean government, regional authorities and citizens using UGS to adapt to the impacts of COVID-19. The study explored the types of UGS, the policies and plans that should be promoted to utilize UGS including in the post-COVID-19 context.

Three lessons are presented in this paper. First, perceptions and utilization patterns of UGS have changed considerably after the outbreak of COVID-19 in Korea. The utilization pattern of UGS was divided into cases of reducing the use of UGS to keep social distancing or increasing the use of UGS to maintain health or replace other restricted facilities. Overall, an increased number of people have started to recognize the importance of urban greenery. Second, during the pandemic in Korea, there were cases in which UGS were actively used by programmes to contribute to environmental conservation, and at the same time to help people overcome "corona blues" (COVID fatigue) which refers to overall negative emotions and anxiousness felt under the threat of COVID-19 and life undersocial restrictions. In addition, there was a higher tendency for citizens to visit national parks and indoor gardens to pursue an 'in-nature' lifestyle beyond indoor facilities or spaces. Lastly, the Korean government is clearly aware of the need for increased UGS. All levels of government, including national, provincial and local, are actively planning to address the demand for UGS with policies that increase urban greenery and build urban forests.

This paper explores the significance of using UGS within an EbA approach by analyzing how Korea used UGS as a leading country for COVID-19 response. The

experience of Korea in utilizing UGS as EbA to respond to COVID-19 and adapt to the current or other pandemics can be shared and utilized for developing cost-effective and nature-friendly pandemic response strategies. Ultimately, this paper aims to contribute to discussions on increasing urban adaptability and resilience to pandemics and climate change, and on the value of green infrastructure as an effective tool in urban planning and design.

1. INTRODUCTION

1.1. What is urban green space (UGS)?

With growing urbanization, the number of people living in urban areas is increasing. In 2018, 55% of the global population resided in urban areas, and this proportion is expected to grow to 68% by 2050 (UN, 2019). As an increasing number of people live in cities, there is a growing demand for green spaces for relaxation, gathering and other recreational activities. In addition, there has been an increasing global demand for urban green space as a provider of nature-based solutions to address environmental concerns such as pollution control, biodiversity conservation and energy savings. Sustainable Development Goal (SDG) 11 focuses on developing sustainable cities and communities and creating public green spaces is one way to make cities sustainable (UNDP, 2021). The creation of UGS is becoming increasingly important in urban design and planning (Feltynowski & Kronenberg, 2020). The following sections cover the definition of the term ‘urban green spaces’ and their various benefits.

1.1.1. Definition of UGS

Currently, there is no universally accepted definition of UGS. Due to the ambiguity of boundaries, UGS is defined differently depending on the purpose and context in which it is used. The most widely used definition of UGS in European studies is based on the definition from the European Urban Atlas (European Union, 2011; WHO, 2016). According to the European Urban Atlas classification system, green urban spaces are public areas such as gardens, parks, zoos and castle parks. These places are primarily used for recreation. Suburban natural areas are also classified as urban parks or managed similar to urban parks and green areas.

Taylor and Hochuli (2017) presented two different interpretations of green space. The first one refers to ‘bodies of water or areas of vegetation in a landscape, such as forests and wilderness areas, street trees and parks, gardens and backyards, geological formations, farmland, coastal areas and food crops’. This interpretation is a broad definition of nature or natural areas, which could be a synonym of nature and antonym of urbanization. The second interpretation of green space is ‘urban vegetation, including parks, gardens, yards, urban forests and urban farms – usually relating to a vegetated variant of open space’. This illustrates green space as a type of open space, which could be considered a subcategory of the broad concept that restricts green space to urban environments.

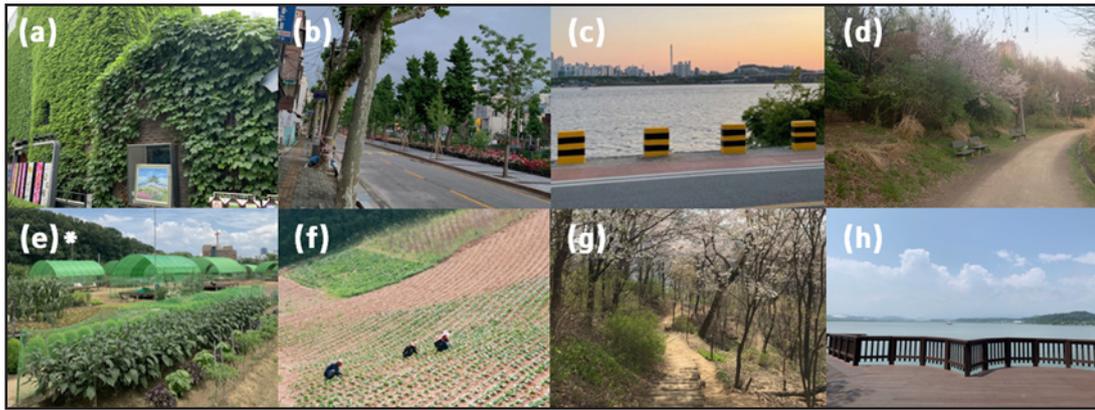


Figure 1. Examples of each category of UGS

(a) green wall, (b) street green and green verge, (c) riverbank green, (d) large urban park, (e) allotment, (f) arable land, (g) forest, (h) lake

Source: Authors, 2021; Jeong, 2021*

Varying forms of UGS exist depending on types of vegetation, its elements, purpose, and degree of segmentation. Cvejić et al. (2015) categorize types of UGS into green, partly green and grey, blue spaces with water such as wetland sand green space not classified as urban but located close to cities. According to this classification system, UGS are divided into eight categories and 44 elements (Table 1). Figure 1 illustrates one element for each category.

Table 1. The categories and elements of UGS

Source: Modified from Cvejić et al., 2015

Category	Green space element
Building green	balcony green; ground based green wall; facade-bound green wall; extensive green roof; intensive green roof; atrium
Private, commercial, industrial, institutional UGS and UGS connected to gray infrastructure	bioswale; tree alley and street tree, hedge; street green and green verge; house garden; railroad bank; green playground, school ground
Riverbank green	riverbank green
Parks and recreation	large urban park; historical park/garden; pocket park; botanical garden/arboreta; zoological garden; neighborhood green space; institutional green space; cemetery and churchyard; green sport facility; camping area
Allotments and community gardens	allotment; community garden
Agricultural land	arable land; grassland; tree meadow/orchard; biofuel production/agroforestry; horticulture
Natural, semi-natural and feral areas	forest (remnant woodland, managed forests, mixed forms); shrub land; abandoned, ruderal and derelict area; rocks; sand dunes; sand pit, quarry, open cast mine; wetland, bog, fen, marsh
Blue spaces	lake, pond; river, stream; dry riverbed, rambla; canal; estuary; delta; sea coast

This paper mainly focuses on human interaction with UGS in the pandemic era. Therefore, the definition and classification of UGS are also considered in terms of citizens' accessibility. This paper defines the term UGS as *any urban green infrastructure, including networks of all-natural, semi-natural and artificial ecosystems, within, around, and between urban areas* (Cilliers et al., 2012). Also, types of UGS are divided into five categories based on their use (Table 2).

Table 2. The categories and elements of UGS in this report
Source: Authors, Korea University

Category	Green space element
Parks	small parks, children's parks, historical parks, waterside parks, cemetery parks, sports parks, urban agricultural parks, etc.
Gardens	backyards, botanical gardens, etc.
Roadside greenery	street trees, shrubs, herbaceous plants, etc.
Landscape around buildings	trees, shrubs, green walls, green roofs, etc.
Waterside green spaces	coastal, riverside, lakeside green spaces

1.1.2. Benefits of UGS

UGS play important roles in making our cities more sustainable by providing nature-based solutions. The benefits of UGS include regulating urban climate, pollution control, biodiversity conservation, energy saving, greater property value, improved human health, recreation and wellbeing according to studies (Haq, 2011). There are various ways to classify benefits of UGS. In this paper, benefits of UGS are simplified into two categories – i) environmental, and ii) social and psychological benefits (Figure 2).



Figure 2. Environmental, social and psychological benefits of UGS
Source: Authors, Korea University

Many environmental problems such as habitat fragmentation, biodiversity loss, air and sound pollution are associated with increased urbanization. UGS provides environmental benefits proven to alleviate these problems. First, UGS support urban wildlife by providing a habitat for both native and non-native species. Also, it can act as a linkage between urban and rural areas (Haq, 2011). Second, UGS plays a vital role in mitigating intense heat in cities (Choi et al., 2012). According to a study of 30 parks in Beijing, parks could reduce the average temperature by 2.3-4.8°C (Lin et al., 2015). Third, urban vegetation can sequester carbon dioxide through photosynthesis and decrease levels of air pollutants (Nowak et al., 2006). A recent study conducted in Korea showed that the mean CO₂ uptake and the fine particulate matter (PM_{2.5}) deposition on street trees per unit area were 0.6 ± 0.1 t/ha/y and 2.0 ± 0.3 kg/ha/y, respectively (Jo et al., 2020). Additionally, it can contribute towards rainwater drainage and flood mitigation (Bai et al., 2018; Bolund & Hunhammar, 1999).

In addition to ecological benefits, UGS serve as living and recreational spaces, providing social and psychological benefits. UGS improve the quality of life of urban residents and contribute to the sustainability of the city (Kabisch et al., 2015). First, UGS provide people with places for physical activities such as walking, running and sports. Second, public UGS such as schoolyards and parks were found to be essential for children and adolescents in facilitating social relations (Seeland et al., 2009). Third, UGS that provide space for social interactions are vital in reducing social isolation and promoting a sense of community (Kim & Kaplan, 2004; Seeland et al., 2009). Also, contact with natural environments has positive effects on mental health and may help to reduce stress (Hedblom et al., 2019; Lee et al., 2015).

1.2. A novel pandemic threatening society: COVID-19

1.2.1. The origin and spread of the COVID-19

COVID-19 is an ongoing pandemic caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). SARS-CoV-2 belongs to the family of Coronaviridae which includes pathogens responsible for the past Severe Acute Respiratory Syndrome (SARS) (2002-2004) and Middle East Respiratory Syndrome (MERS) (2012-present) pandemics (Drosten et al., 2003; Zaki et al., 2012; Zare et al., 2021). As it is well known, COVID-19 emerged in December 2019 in Wuhan city, Hubei province, China (Yang et al., 2020). It is defined as a zoonotic disease, which is caused by the pathogen transmission from animals to humans.

The symptoms of COVID-19 can be similar to that of pneumonia, demonstrating significant respiratory symptoms. Common signs include fever, dry cough, fatigue, and muscle pain, in addition to diarrhea, hemoptysis, and loss of taste or smell in some cases (Huang et al., 2020; Menni et al., 2020; Wang et al., 2020). The majority of people

infected with the virus experience mild to moderate illness and recover through their immune system. COVID-19 represents a greater risk of disease severity with increasing age that is partially due to the underlying, preexisting diseases of the patients (Ali & Alharbi, 2020; Stawicki et al., 2020).

The experience since 2020 shows that COVID-19 is spread by human-to-human contact and via aerosols produced from coughing and sneezing entering respiratory organs (Lotfi et al., 2020). The virus inside the aerosols can survive for periods ranging from two hours to a few days (Riddell et al., 2020). The contagion rate of COVID-19 is so high that countries, including most developing countries that lack large scale medical facilities and healthcare management systems, opted to lockdown their borders (Kang et al., 2020), denying entry from countries with a high number of infections. Also, regional closures were applied to cities that experienced a rapid spread of the disease: Wuhan (China) and Tokyo (Japan), for instance (Inoue & Todo, 2020). In Korea, those who tested positive for COVID-19 were quickly quarantined, and their movements were traced and this data released to the public. Suspected patients whose movement overlapped with confirmed cases – meaning possible contact – were tested for infection or self-isolated (Kang et al., 2020). Despite intense efforts to prevent the spread, cases of COVID-19 infection have been reported in more than 210 countries worldwide and even in Antarctica. The global real-time status of COVID-19 by the World Health Organization (WHO) shows, as of October 2021, 20 months after the outbreak began, the total number of confirmed cases has risen to over 241 million, with over 4.9 million deceased. Considering asymptomatic patients and countries that have not released the statistics, the actual number of infected cases is expected to be much higher.

1.2.2. COVID-19 impacts on society and environment

1.2.2.1. Public health aspects

COVID-19 significantly changed people's lifestyles. Interestingly, one positive effect of COVID-19 on public health has been reported. To halt the spread of the virus, governments worldwide implemented hygiene rules such as wearing face masks and regular hand washing. As people began to follow them, common respiratory diseases, including cold, pneumonia, asthma, and other viral infections noticeably decreased (Huh et al., 2021; Pranay et al., 2021; Tan et al., 2020). In Korea, the number of patients visiting hospitals with respiratory infections from March to July 2020 decreased by 52%, compared to the same period in 2019 (NHIS, 2020). Social distancing also reduced the incidence of infectious diseases other than COVID-19 (Nolen et al., 2020). Also, the pandemic significantly reduced human activities. To halt further spread of the disease, people were advised or sometimes forced to stay at home to keep a distance from each other. Border closures, regional lockdowns, and/or social distancing – government regulations keeping people physically

distanced indoors – were employed in most countries, including Korea, Japan, India, Australia, and countries in North America and Europe. Table 3 shows the detailed social distancing measures placed in Korea in 2020. The level of the measures has been scaled up or down regularly, depending on the spread of the disease. Pieh et al. (2020) reported the psychological distress experienced by the general population across the entire age spectrum, and several studies suggest that mental health issues have worsened because of the prohibition of everyday activities and reduced access to nature related activities (Brooks et al., 2020; Tomasso et al., 2021). Some of the mental and emotional health issues include: “Stress, depression, anxiety, feelings of panic, feelings of hopelessness, frustration, feelings of desperation, and struggles with suicidal ideation and behavior, insomnia, irritability, emotional exhaustion, grief, and traumatic stress symptoms.” (Turmaud, 2020)

Table 3. Three-level scheme and social distancing measures in 2020
Source: Modified from Government of the Republic of Korea, October 2020

Level	Situation	Prevention and Control Measures			
		Gatherings and Events	Public Facilities	School	Work Pattern
Level 1	Repeated spread and mitigation of small-scale sporadic cases under the control of the healthcare system.	Compliance with quarantine rules at gatherings, events, and sporting events (with audience restriction).	Use of publicly used facilities is allowed in principle, but in case of high-risk facilities, it is mandatory to comply with the core quarantine rules.	Compliance with the quarantine rules while attending both regular and remote classes.	The public sector utilizes flextime and telecommuting at an appropriate rate per department. The private sector is encouraged to follow the same measures as the public sector.
Level 2	The public sector utilizes flextime and telecommuting at an appropriate rate per department. The private sector is encouraged to follow the same measures as the public sector.	Enforcement of an administrative order banning all private and public gatherings and events with 50 or more indoors and 100 or more outdoors people. Sporting events continue with no spectators.	In principle, public facilities are closed (operation is possible when contact-free service is available). Among private facilities, high-risk facilities such as entertainment facilities are suspended and are required to take preventive measures to mitigate the risk of mass infection.	Combination of attending school and distance learning to minimize density to reduce the number of students attending school.	Combination of attending school and distance learning to minimize density to reduce the number of students attending school.
Level 3	Multiple cases of mass infection in the community, COVID-19 is spreading rapidly and on a large scale.	All meetings where 10 or more people meet face-to-face are banned. All sporting events are suspended.	All public, private, and high to mid-risk facilities are suspended.	Suspension of classes at school. Distance learning and telelearning to continue or close down.	Except for essential personnel, all public sector employees to work from home. Private sector employees also are recommended to work from home.

To cope with the mental and emotional repercussions of COVID-19, green spaces have become an essential source of resilience for people during lockdowns and restrictions, especially in urban areas. Due to their accessibility, green open spaces such as parks can substitute indoor facilities as gathering areas for small groups of people while maintaining social distancing. Figure 3 shows a creative design of a green area in Poland where people can engage in outdoor activities while complying with

the distancing rules. The idea is that such places can alleviate social isolation and positively impact physical and mental wellbeing (Geng et al., 2020). Hence, studies emphasize the importance of systematic responses to COVID-19 through planning and designing urban green infrastructure that enhances community resilience (Kang et al., 2020; Shoari et al., 2020; Uchiyama & Kohsaka, 2020; Xie et al., 2020). For instance, Kang et al. (2020) suggest improving pedestrian paths and bicycle paths in urban residential areas, which may require redesigning of streets. This is expected to help in accommodating the needs of residents, providing equal resources to people during future pandemics and generating green spaces to meet the outdoor activity demands of the residents (Honey-Rosés et al., 2020).

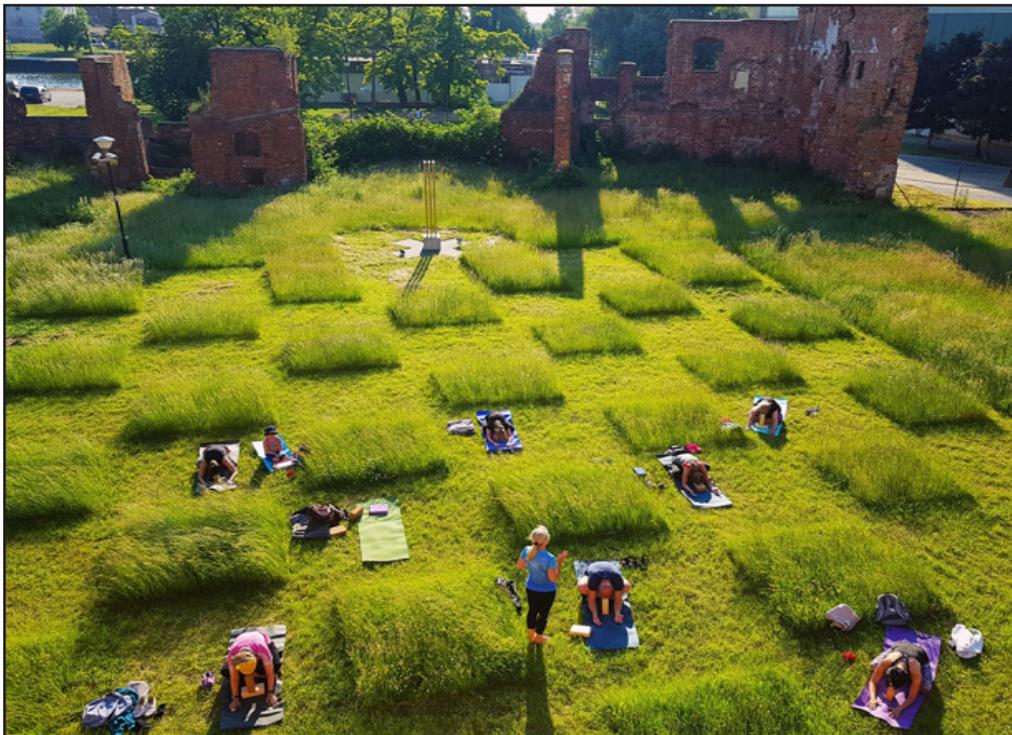


Figure 3. The lawn in front of the Centrum Sztuki Galeria EL art gallery in Elblag, Poland. It was mowed in a checkboard pattern, which enabled citizens to relax while maintaining social distancing.
Source: Lubell, 2020

1.2.2.2. Economic aspects

COVID-19 also presents challenges to the global economy, food systems and labor markets. Given the current social atmosphere of uncertainty, consumers are either reluctant or find it challenging to purchase goods and services, and companies are likely to postpone investments and sales of products (Goolsbee & Syberson, 2021; ILO, 2020). Such changes and shrinkage in supply (production of goods and services) and demand (consumption and investment) have resulted in an economic recession. For instance, lockdowns and gathering restrictions represent a setback for farmers,

hindering their access to markets where they buy supplies and sell their produce (WHO, 2020). Also, agricultural workers have been prevented from harvesting crops, thus disrupting domestic and international food supply chains, which resulted in reducing the availability of healthy, safe, and diverse diets (WHO, 2020).

Meanwhile, COVID-19 has deepened global unemployment challenges, as various enterprises were subjected to closure or poor financial performance because of restrictions. Millions of people lost their jobs, and many people could not find new employment (Coibion et al., 2020). The pandemic has hit informal sectors and casually employed workers particularly hard. According to International Labour Organisation (ILO) statistics, global employment losses during 2020 were massive; 114 million jobs were lost relative to the pre-pandemic era of 2019 (Table 4). Undoubtedly, COVID-19 has resulted in a sizable amount of the global workforce losing their livelihoods, plunging millions of people into poverty (ILO, 2021).

Table 4. Global employment losses and changes in unemployment rate by regions relative to 2019
Sources: Modified from ILO, 2021

	Employment loss (millions)	Rate (%)
World	114	-2.7
Arab States	1.1	-2.0
Northern Africa	2.3	-2.1
Sub-Saharan Africa	1.7	-2.2
Northern America	10	-4.0
Latin America and the Caribbean	28	-6.3
South-Eastern Asia and the Pacific	7	-2.2
Central and Western Asia	2.3	-2.4
Northern, Southern, Western Europe	3.6	-1.1
Eastern Europe	3.2	-1.2
Southern Asia	38	-3.5
Eastern Asia	17	-1.5

1.2.2.3. Environmental aspects

Reports and studies have shown that COVID-19 affects the environment both negatively and positively. The increase in medical waste and single-use plastics has negatively impacted the environment. Since many countries imposed restrictions such as lockdowns and quarantines, and with more people at home, the abrupt decrease in anthropogenic emissions brought about a considerable improvements in urban air

quality and the quality of water bodies and a temporary decline in greenhouse gas emissions.

A rising interest in extending these positive effects to post-pandemic or future pandemic contexts aligns with global environmental realities and challenges such as climate change. There is a growing consensus on ‘building forward better and greener’ and not going back to business as usual after the pandemic. Hence various countries are focusing on Green New Deal ideas, including Korea (Chowdhury, 2021).

There are also rising concerns regarding the disposal of the waste produced specifically due to the COVID-19. To control the transmission of the disease and to treat the patients, face masks, hand gloves, and other medical products are being produced and then disposed of, ultimately resulting in water and soil pollutions (Birsal, 2020; Singh et al., 2020; Sivakumar, 2020). Fadare and Okoffo (2020) suggest that face masks and other plastic-based products are potential microplastic pollutants. Primarily, polypropylene, a universally used plastic, is used to make N-95 masks (respirators that filter more than 95% of airborne particles) and Tyvek (a synthetic material with high-density polyethylene fibers) protective suits and gloves. Also, single-use plastic containers that can minimize human contact have been widely used in cafes and restaurants, resulting in a surge in plastic waste (Newburger & Lucas, 2020; Silva et al., 2020). Such plastic-based products take a long time to be decomposed and release hazardous elements like dioxin into the environment (Singh et al., 2020).

During 2020, there was a decrease in air pollutants, including fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and carbon monoxide (CO), produced by the combustion of fossil fuels and other industrial processes (Bauwens et al., 2020; Giani et al., 2020; Ju et al., 2021; Nakada & Urban, 2020; Otmani et al., 2020; Querol et al., 2021). According to Khan et al. (2020), $PM_{2.5}$, a dangerous air pollutant, has declined in cities around the world. This decline was observed by comparing its levels before and during the lockdown period in early 2020. The cities studied by Khan et al. include Madrid (Spain), São Paulo (Brazil), New York (US), Delhi (India) and Seoul (Korea). In China, the European Space Agency (ESA) (2020) found a noticeable decrease in atmospheric NO_2 levels before and after the lockdown in China (Figure 4).

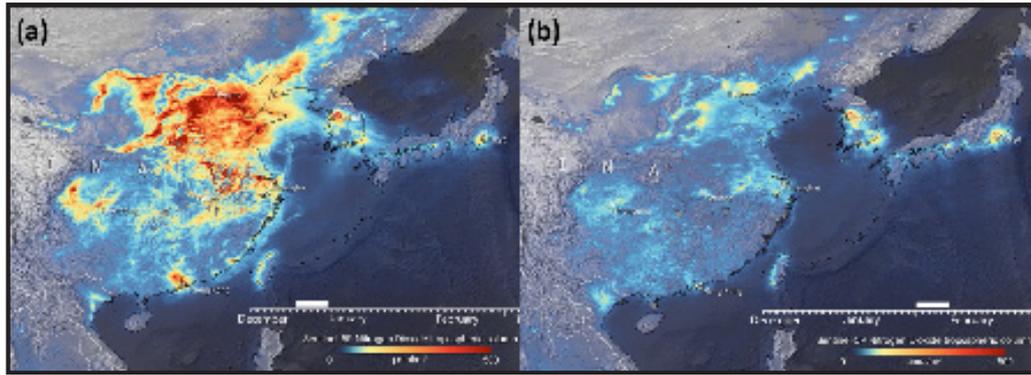


Figure 4. NO₂ emission changes between (a) 1-10 January and (b) 1-10 February in the Northeast Asia region in 2020
Noticeable declines were observed in China
Source: ESA, 2020

Carbon dioxide (CO₂) is one of the major greenhouse gases responsible for climate change due to emission sources such as transportation, industries, and electricity generation (Khan et al., 2020). Historical records show a gradual rise in CO₂ emissions along with industrial development and short-term drops during financial crises such as the Great Depression and World War II (IEA, 2020). Likewise, the reduction in energy use and the economic downturn following the COVID-19 outbreak resulted in the reduction of CO₂ emissions (IEA, 2020).

Water pollution is a common challenge in developing countries, where domestic and industrial wastes flow into nearby rivers and lakes without being treated (Bodrud-Doza et al., 2020; Yunus et al., 2020). However, currently, during the lockdown, the Ganga and Yamuna rivers in India appear to be cleaner because of the reduction in industrial and sewage effluents (Rume & Islam, 2020). Clean waterbodies positively affect local biodiversity, enabling species to return to their natural habitats (Khan et al., 2020). In Venice, Italy, canal waters showed much clearer transparency and aquatic life reappeared during the lockdown from March to April 2020, compared to the pre-lockdown period (Cheval et al., 2020; Clifford, 2020). Braga et al. (2020) reported that the improvements are partially due to anthropogenic factors, such as the reduction in vessel traffic of commercial and tourist motorboats and wastewater disposals.

However, the decline in greenhouse gas (GHG) emissions and pollution may only be temporary. Without significant changes in the management of energy systems and the sources of the industrial pollutants, their concentrations in air and water bodies are expected to increase again when the disease subsides, following the concurrent, macroscopic trend (Hale & Leduc, 2020).

Overall, with COVID-19, the reduction of carbon-intensive human activity has positively affected the environment, and this change has also been felt by ordinary

citizens, academics and policymakers. As such, public awareness of the need for reducing GHG and pollutant emissions is hoped to continue during the post-pandemic era. However, there is the worry that, post-pandemic, people will go back to business as usual in terms of their approach to nature.

The Peoples' Climate Vote conducted in 2020 provides a good indication of the state of affairs in this respect. With 1.2 million respondents, this vote was the largest public opinion survey on climate change. With a new approach to polling, this vote spanned over 50 countries covering 56% of the world's population. In partnership with the University of Oxford and several NGOs, UNDP undertook this survey to educate people about climate change solutions and ask them about the actions that they think governments should take. It aimed to connect the public to policymakers and provide the latter with reliable information on whether people considered climate change an emergency and how they would like their countries to respond (UNDP, 2021).

The Peoples' Climate Vote found that nearly two-thirds (64%) of people in 50 countries believed that climate change was a global emergency – presenting a clear and convincing mandate for decision-makers to increase their ambition levels in commitments under the Paris Agreement. Among the people who said that climate change is a global emergency, 59% said that the world should do everything necessary and urgently in response. Meanwhile, 20% said people should act slowly while they learn more about what to do. 10% of people said the world is already doing enough, while 11% noted doing nothing as the response. While a solid majority of people believe climate change is a global emergency, the fact that 41% of them did not demand urgent and comprehensive action in response suggests that more education and awareness is required even for those people who are already concerned about climate change (UNDP, 2021).

1.3. UGS as an Ecosystem-based Adaptation (EbA) Approach

The COVID-19 pandemic needs adaptation strategies as there is no precise estimate of how long the pandemic will continue. This uncertainty and the strong contagiousness of the virus have disrupted the lives of millions of people worldwide, and it is expected that detrimental effects of this virus at the personal and social levels will persist for years (Haktanir et al., 2020). Although several vaccines have been developed, the Coalition for Epidemic Preparedness Innovations estimates global vaccine manufacturing capacity at 2–4 billion doses annually and that it will be 2023–2024 before enough vaccines can be manufactured (CEPI, 2020). COVID-19 is neither the first nor the only risk that global society will face (Phillips et al., 2020). In this context, central and local governments and local communities have to develop adaptation strategies to reduce disease risks in a sustainable manner that synergize biodiversity and health needs

(FEBA, 2020). These strategies will need to be comprehensive, providing integrated policy solutions for the numerous socioeconomic and health challenges exacerbated by COVID-19. In this context, EbA can contribute to sustainability discussions and wider adaptation strategies.

The concept of EbA has grown in profile and importance since it was officially defined by the Convention on Biological Diversity in 2009 (UNEP, 2019). It is defined as ‘the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change’ by the Ad Hoc Technical Expert Group of Convention on Biological Diversity. The Commission on Ecosystem Management of the International Union for Conservation of Nature dealt with the idea of EbA in discussions on ‘how the world should address climate change impacts on natural and human systems, including ecosystems and the services they provide to society and communities’ (Andrade Pérez et al., 2010). In this report, eleven case studies were conducted in different ecosystems and regions, assessing the climate change impacts on local communities or biodiversity at the ecosystem level, and analyzing the climate change vulnerability of ecosystems and human communities. Also, proposals for adaptation measures were made. In this context, EbA was presented as a sustainable strategy that promotes the resilience of ecosystems and human society in adapting to climate change and other global phenomena. EbA is related to the idea that ecosystems have natural adaptive capacity and resilience. Well- or sustainably-managed ecosystems can self-enhance their ability to adapt to the impacts of climate change and reduce human vulnerability to climate change impacts and hazards (Figure 5). Compared to technology and climate-resilient infrastructure, ecosystems offer relatively cheaper and effective ways to adapt to climate change and reduce disaster risk (Colls et al., 2009). EbA is gaining increasing attention as a cost-effective approach that can be applied easily, irrespective of technological capacity or socioeconomic conditions.

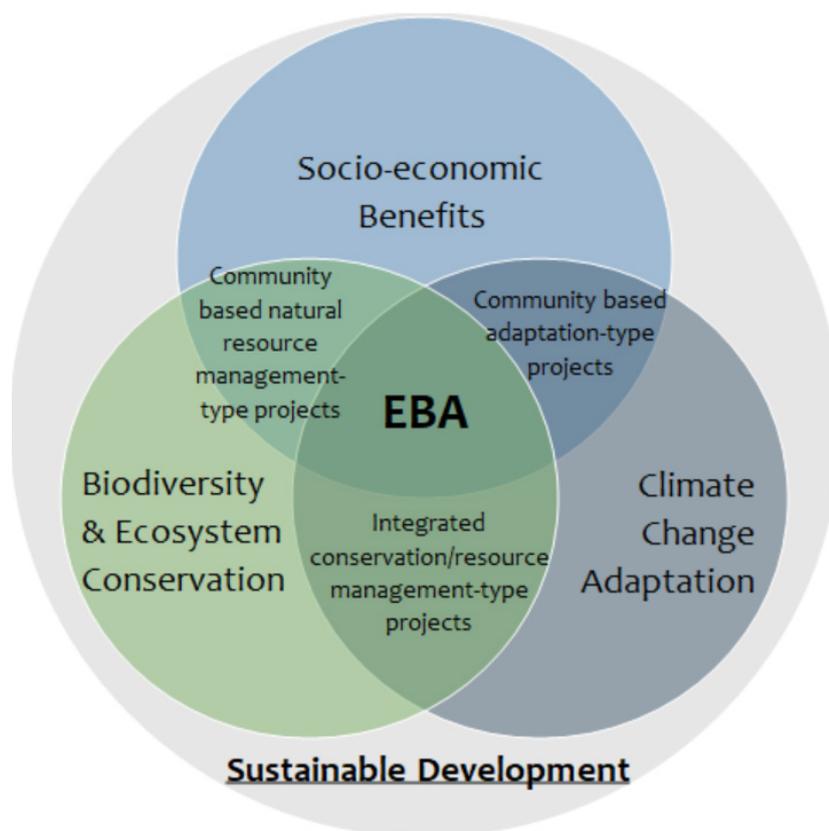


Figure 5. Linkages between EbA and other sectors
Source: Midgley et al., 2012; FEBA, 2017

Activities within the scope of EbA include sustainable water management, the establishment of diverse agricultural systems and the management of forests. For example, to prevent droughts, the conservation of watersheds (forest, wetland, etc.) and the implementation of agroforestry practices can be conducted as part of an EbA approach (USAID, 2017). In Bolivia, an approach integrating both EbA and hard infrastructure was adapted to improve the country's resilience to repeated droughts. The strategy aimed to improve forest water recharge and storage capacity was led by the Swiss Development Cooperation, working alongside local communities (Doswald & Estrella, 2015; USAID, 2017). Similarly, in Sweden, ponds, green roofs and green spaces were used for sustainable urban drainage systems adapted to increasing floods brought on by climate change. This EbA approach also had social effects such as growth in employment, increased financial security and improved livelihoods of local stakeholders (Naumann et al., 2013).

By integrating EbA approaches in developing these strategies, recovering from COVID-19 and building systems back better and greener is possible (FEBA, 2020). EbA will be a key mechanism for green recovery as it accounts for environmental and climatic drivers to support human society and build resilience (Rizvi et al., 2015).

2. LINKING URBAN GREEN SPACE AND THE COVID-19 PANDEMIC

2.1. The growing significance of UGS during COVID-19

As shown in section 1.1.2, UGS provide various benefits. This paper highlights the roles and benefits of UGS as an EbA approach to COVID-19. Here, changes in public perception or usage of UGS will be examined. As per the ‘COVID-19 Community Mobility Report’¹ from Google on 21 May 2021, the overall mobility to parks in various countries has increased compared to baseline² use pattern in normal winters before the outbreak of COVID-19 (Google, 2021) (Figure 6). Even though daily mobility fluctuates according to each countries’ circumstances, the overall trends show an increased tendency to visit parks during the spring and summer seasons when people enjoy outdoor activities.

In Korea, citizens preferred parks and open spaces rather than indoor spaces such as theaters, restaurants or cafes. It seems that they tried to avoid close-contact spaces to follow social distancing and quarantine guidelines (Ahn, 2020). The importance of UGS grew as people made drastic lifestyle changes and refrained from being in contact with others and visiting confined spaces. Even a new term, ‘corona blues’ became popular in Korea to illustrate the negative emotions and anxiousness from dramatic changes in people’s daily lives due to the spread of COVID-19. During this period, several studies have been conducted to evaluate citizens’ mental health, and UGS seem to enable the public to spend time outside to ward off the corona blues (or COVID fatigue) and alleviate their worries and fears.

¹ The COVID-19 Community Mobility Reports aim to provide insights into what has changed in response to policies aimed at combating COVID-19. The data shows how visits to places, such as grocery stores and parks, are changing in each geographic region (Google, 2021).

² The baseline is the median value, for the corresponding day of the week, during the 5- week period Jan 3–Feb 6, 2020 (Google, 2021).

Using Urban Green Spaces in the Pandemic:
Example from the Republic of Korea

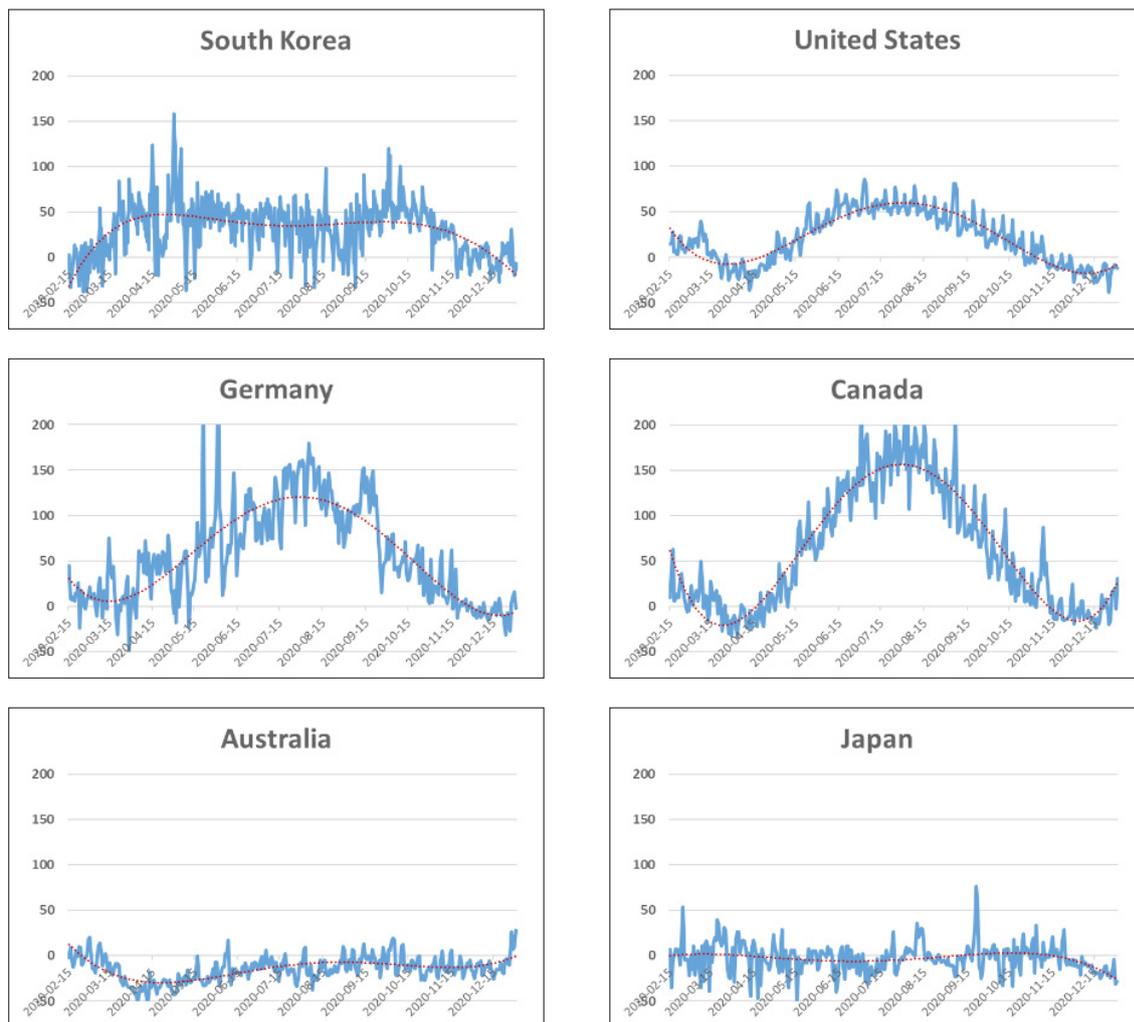


Figure 6. Change of mobility for parks from 15 February to 31 December 2020
Source: Modified from Google Community Mobility Reports

In addition, the '2025 Future Housing Trend Report' by the Korea Housing Institute includes the results of a 2016 survey on the factors Koreans considered when selecting future housing; the results are as follows: 'comfort' ranked first at 35% (Figure 7), followed by 'convenient public transportation (25%)', 'convenience facilities (19%)', among others. Also, the '2020 Quality of Life Report' released by the National Statistical Office reported that satisfaction with the natural environment such as mountains and parks in residential areas was about 58.7%. It was around 42% until 2016, but increased steadily to 50.2% in 2018.

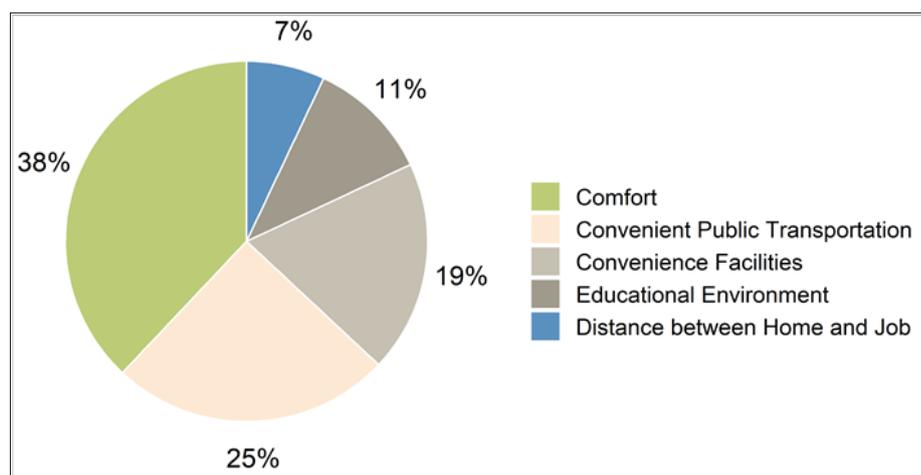


Figure 7. The factors in considering future housing
Source: Korea Housing Institute, 2016

It may be inferred that the emergence of fine dust increasingly being seen as a hazard that is close to becoming a disaster³ in Korea⁴. People have become more concerned about the health impacts of fine dust on their health, and their concerns have been exacerbated during the COVID-19 period. These surveys demonstrate that the demand for UGS is high as the pandemic continues. There are two reasons why UGS have become more critical with time: The first reason is that UGS acts as a recovery tool. It can be both a physical vaccine and a psychological tool. The increase of physical activities can help reinforce people’s immune systems (Rook, 2013; Shi et al., 2020, Lu et al., 2021), and outdoor (in nature) physical activities provide additional benefits that indoor activities cannot. Also, due to the growing awareness of virus transmission, outdoor activities have replaced indoor activities (Pretty et al., 2005, Lu et al., 2021). As a psychological or therapeutic tool, UGS help to alleviate physical, social, and mental isolation from social distancing, in addition to its own benefits. With COVID-19, isolation and dissatisfaction are deepened because people are restricted in how they can cope with the stresses of everyday life. According to a survey conducted by Expedia (2015), a global online travel agency, of office workers in Korea, Taiwan, and Hong Kong in 2015, all three countries chose ‘travel’ as the best way to compensate for the tension and stress in life (56.7% of Korean, 47.4% of Taiwanese, and 50% of Hong Kong respondents). This was followed by cultural activities (19.7% in Korea, 21.8% in Taiwan, and 20% in Hong Kong) and sports. During the pandemic, lockdown and social

³A hazard is any phenomena that has the potential to cause destruction to life and property. A hazard become a disaster when the potential to cause destruction is fulfilled. When there is harm to life and property of humans, the hazard is termed a disaster (Babu, 2017).

⁴ Fine dust was declared as a social disaster by the Korean government, as 97% of Koreans responded that air pollution was causing them physical or psychological pain in a survey by the Ministry of Environment in 2018 (Bicker, 2019).

distancing measures have forced people to give up their leisure activities and embrace telecommuting for work.

Consequently, not getting sufficient fresh air and sunlight, enjoying little to no physical movement or exercise and being isolated have led to considerably greater stress (Jainer & Yadav, 2020). Mental health is a critical issue that needs to be overcome throughout this pandemic. In this context, UGS has become popular as a relatively safe avenue for spending one's spare time.

The second reason is that UGS has gained acceptance as a sustainable solution for cities' fundamental problems. One of the most critical characteristics cities have is the high concentration and easy accessibility to housing, workplaces, other major facilities and infrastructures for life. This indisputable advantage made human density high in many cities worldwide. It is also the main vulnerability that cities have in a pandemic. In this context, UGS is a relatively safe solution especially during the pandemic. Since most traditional recreational facilities in the city are closed or indoors, the residents cannot have their needs met.

UGS is mostly open-air and has relatively safe accessibility, making it an excellent alternative to other indoor facilities. Open-air spaces are considered safer for reducing the spread of viruses. Compared to indoor air movement which is often recirculated, outdoor air movement disperses the virus and is comparatively less infectious. Green spaces not only encourage people to visit outdoors more frequently but also for longer durations. It exposes them to fewer viruses by reducing their awake time in indoor environments, especially in group settings (Braubach et al., 2017; Lu et al., 2021). In the long term, UGS can increase the immune system of cities through their environmental benefits and reduce population density by dividing the residential and office zones with green areas. Hence, it is necessary to build a city through urban planning and design that incorporates open green spaces, urban forests, and green infrastructure.

2.2. Survey: Citizens' awareness of UGS in the pandemic context

During 2020 and the first half of 2021, the COVID-19 pandemic has spread all across the world. The pandemic has influenced the behavioral and mobility patterns of people in such a way that green spaces such as parks and gardens have become more popular. (Heo et al., 2020). According to some studies, green spaces can bring considerable benefits to maintaining good health during a pandemic such as relieving stress (Dushkova et al., 2021; Xie et al., 2020). It can be linked to the aforementioned EbA which can be a cost-effective approach against COVID-19.

In recent years, the number of visitors to forests and forest healing⁵ programmes in Korea has increased, and forest visits have become part of people’s lifestyles. However, most forests are far from cities, which means that the accessibility is quite low. In this context, UGS could be a good alternative to forests for citizens (KFS, 2020). Giles-Corti et al. (2005) dealt with the importance of distances to open public spaces. They emphasized that well-designed UGS considering distance, size and attractiveness increase the number of visitors, encourage their physical activities and enhance the health of citizens. According to the Architecture and Urban Research Institute (2020), it is even necessary to expand UGS to include gardens on rooftops or terraces to enhance their accessibility. Meanwhile, Xie et al. (2020) researched the positive effects of UGS providing ecosystem services, they help prevent diseases; enhance physical and psychological wellbeing by providing stress relaxation and strengthening of mental and physical health; and provide people access to beautiful urban scenery. Additionally, these green spaces can improve the climate change adaptative capacity of urban areas by circulating air and water (Pramova et al., 2012).

Based on these ideas, a survey (Annex) was conducted by co-authors to understand people’s perception about UGS with benefits in terms of EbA. The research team from Korea University and UNDP Seoul Policy Centre undertook the survey with the objective to understand how COVID-19 has changed citizens’ perspectives of and attitude toward green spaces and urban forests. The purpose of the survey is to understand citizens’ awareness of UGS and identify the facilities and services that would be needed to encourage their design and provision (Table 5).

Table 5. Description of survey

Items	Contents
Personal characteristics	Occupation and form of work or classes (online, offline, hybrid)
Awareness of UGS	Range, benefits and importance of UGS
Changes of pattern in UGS usage	Number of visits and usage patterns pre- and post COVID-19
Demand for UGS for reducing COVID-19 effects	Appropriate transportation, required time and necessary facilities and service to promote use of UGS

General characteristics of survey participants

The online survey was conducted from 12 April to 28 April 2021. It included 119 male and 95 female respondents (Table 6). The survey was conducted among several age

⁵ “Healing” in Korea often refers to the act of resting, or increasing physical and mental wellbeing

groups, including seniors and youth. However, the majority of respondents were in their 20s to 30s (59%).

In Korea, the typical workplace changed dramatically due to COVID-19, as many companies and organizations have switched to work from home or hybrid setups. The survey showed several types of arrangements; commuting and offline accounted for more than half (55%) and hybrid forms with both online and offline methods accounted for 31%.

Table 6. General characteristics of survey participants

Sample	10s		20s		30s		40s		50s		Over 60s		Total
	M	F	M	F	M	F	M	F	M	F	M	F	
	2	0	38	45	21	23	18	7	27	15	13	5	214
%	0.9		38.8		20.6		11.7		19.6		8.4		100

*F – Female, M – Male

The results of survey

The survey begins with an assessment of how respondents defined UGS. Respondents were given the list below (Figure 8) and asked which of these they considered to be an UGS. Urban forests (86.45%) accounted for the highest portion followed by rooftop gardens (81.78%). People considered not only large areas as UGS such as urban forests, but also green areas inside of buildings such as rooftop gardens. They considered rooftop gardens as a good option as they can provide both physically and visually accessible UGS. In addition, when the survey asked the benefits of UGS, the most popular answer was the purification of the urban environment including countering air, noise and other forms of pollution (38.79%), followed by beautification of urban scenery (24.3%), emotional stability (22.9%), climate control (6.54%), and protection of settlements (2.8%). It can be interpreted that the major function people associate with UGS is preventing fine dust, and it seems to correlate with recent increase in public interest in air pollution such as fine dust.

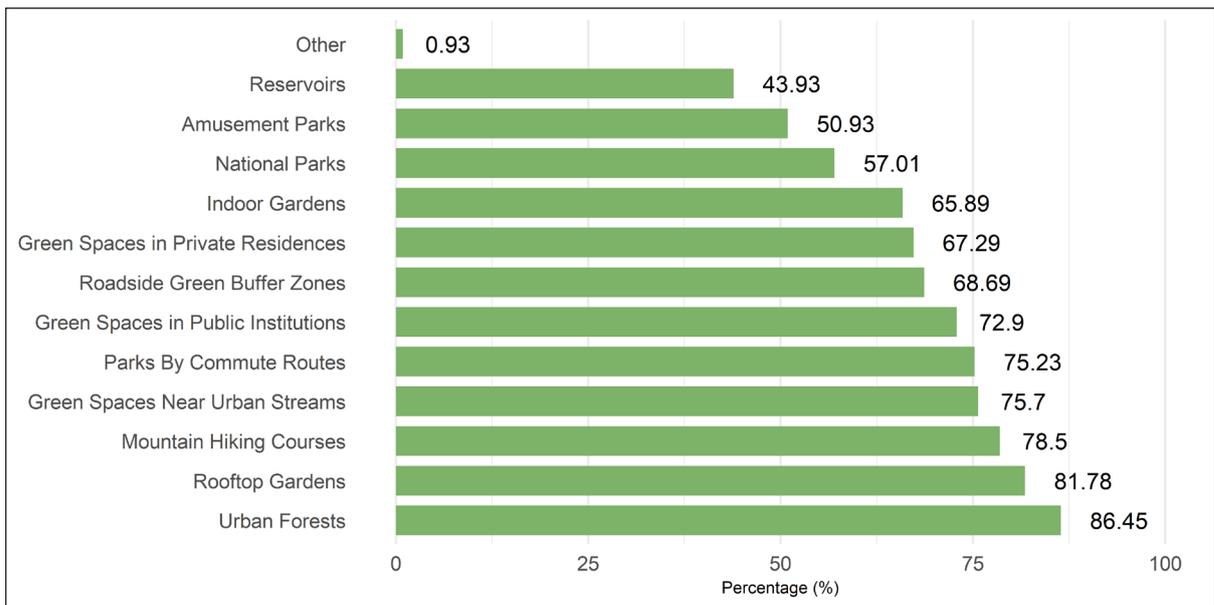


Figure 8. The conceptual range of UGS

Based on the basic perception of UGS, the importance of UGS, frequency and purpose of visits before and with COVID-19 were asked. Figure 9 presents the comparison between perceived importance of UGS before COVID-19 and during COVID-19. When asked about the perceived importance of UGS before COVID-19, it was found that all respondents were generally aware of the importance of UGS. About 36% of the total respondents answered that UGS is very important, and 43% responded that it is important. With COVID-19, about 64% of respondents considered UGS as very important compared to 36% before the pandemic.

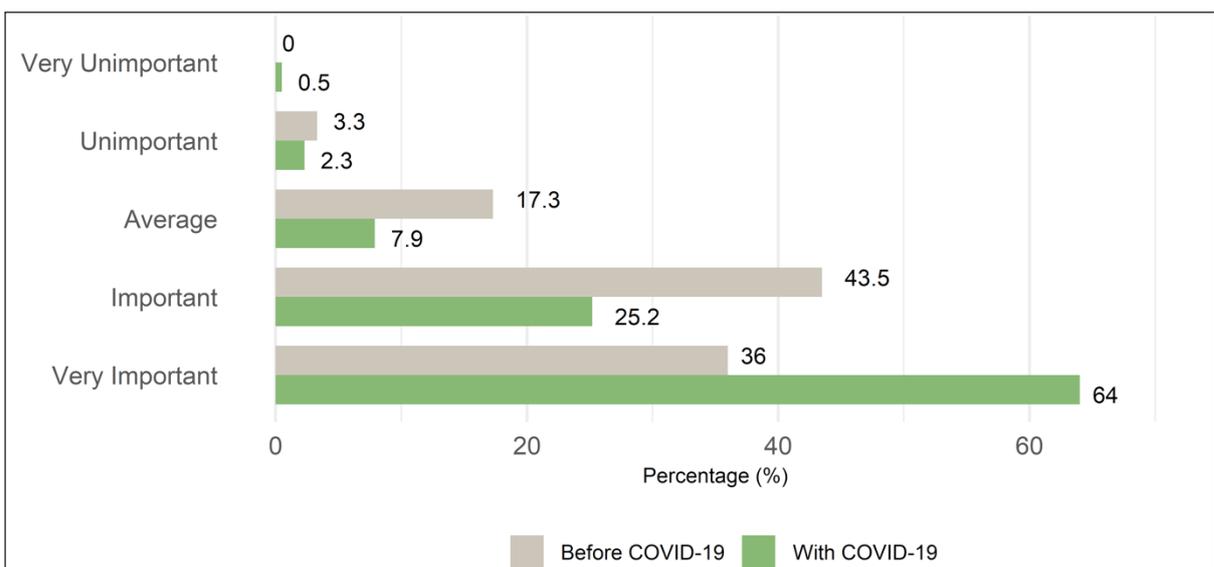


Figure 9. The importance of UGS before and with COVID-19

To understand the change in the frequency of UGS use, the frequency of visits before and with COVID-19 was investigated. The respondents answered that before

COVID-19, they visited UGS in the following order, 1-2 times a week (43%), 1-2 times a month (25%) and almost daily (15%). Since the beginning of the pandemic, the frequency has changed to the following order, 1-2 times a week (34%), almost every day (21%) and rarely (20%) (Figure 10). There was no significant change for respondents who visited UGS every day or almost every day, and who rarely or never visited, whereas most of the users who visited 1-2 times a week had reduced their visits to 1-2 times a month or rare (11%), or increased them to almost every day or maintained them (total 38%) (Table 7).

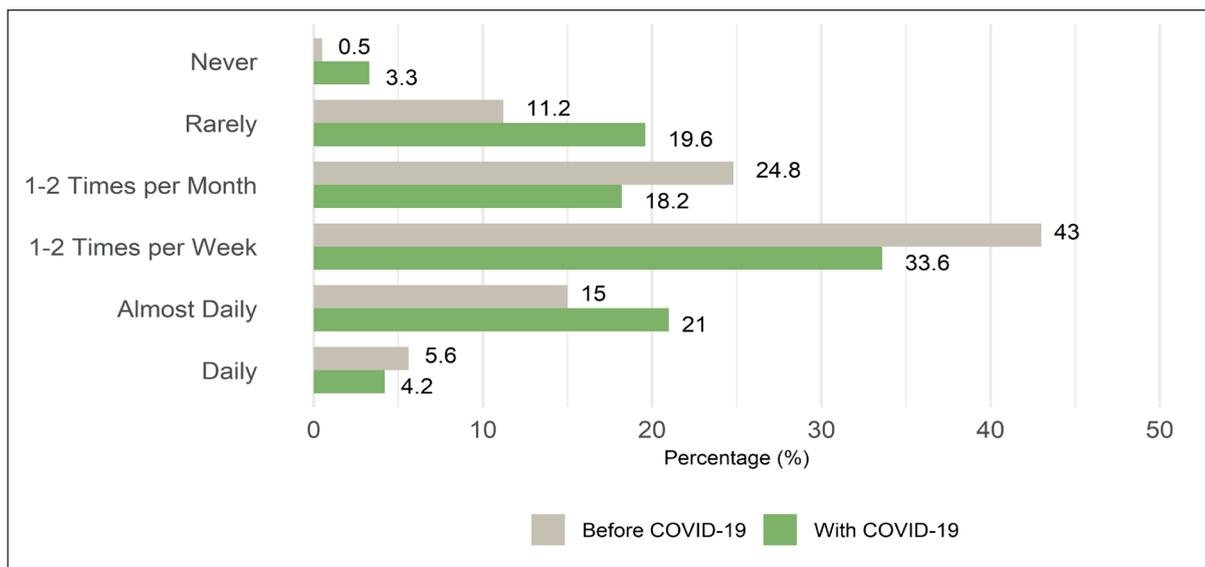


Figure 10. The frequency of utilization of UGS before and in the wake of COVID-19

Table 7. Change of frequency in UGS utilization (unit: %)

		After					
		Daily	Almost daily	1-2 times per week	1-2 times per month	Rarely	Never
Before	Daily	6	5	-	1	-	-
	Almost daily	1	21	-	6	4	
	1-2 times per week	1	16	16	48	10	1
	1-2 times per month	1	2	17	14	17	2
	Rarely	-	1	5	4	11	3
	Never	-	-	-	-	-	1

Factors behind change in utilization patterns were identified through the questions about the purpose of visits before and with COVID-19. Respondents who increased the frequency of use, had increased their visits to replace other restricted facilities (about 27%), to improve psychological health (22%), replace sports facilities (21%) and improve of immunity (17%) (Figure 11). Figure 12 demonstrates how respondents that cited exercise as their main reason to visit UGS before the Pandemic began to visit for a variety of purposes, such as exercise (63.3%), natural contact (63.3%), and relaxation (55.6%) since the outbreak of COVID-19. It can be inferred that people consider large spaces such as parks to help them minimize the spread of disease rather than small spaces such as cafes (Heo et al., 2020). Furthermore, in the wake of COVID-19, there is a higher interest in relaxation and meditation, which is next at 55.6%. This signifies that UGS may help with relieving stress, anxiety and depression (Wood et al., 2017).

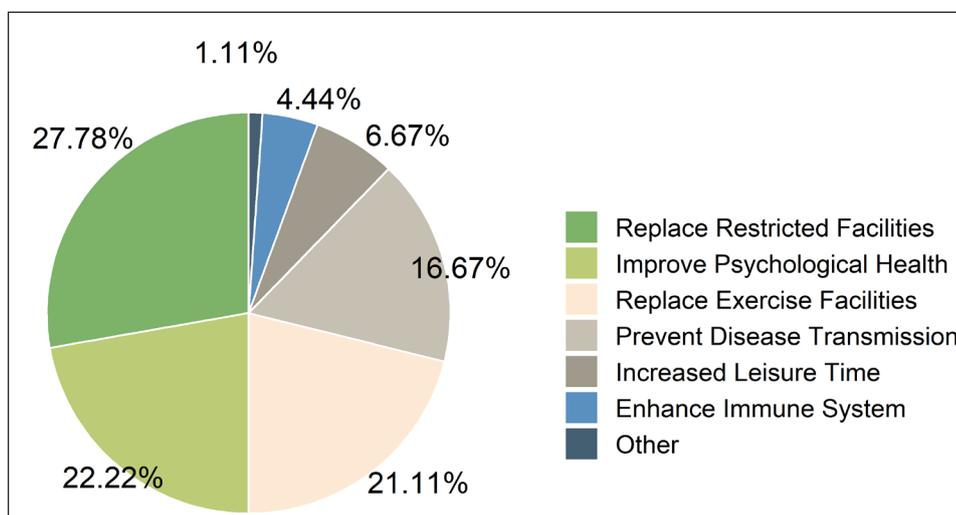


Figure 11. Reasons for increasing the use of UGS in the wake of Covid-19

Figure 12 illustrates the changes in purposes for visiting UGS of respondents who decreased their overall visits during COVID-19. These respondents mainly used UGS for relaxation or meditation (57.3%), spending time with family and friends (55%), exercise (47%) and being in contact with the natural environment (41%) before COVID-19 (Figure 12). After the outbreak of COVID-19, the reasons for visiting that experienced an increase were connecting with nature (45%) and en route to their destination (23%).

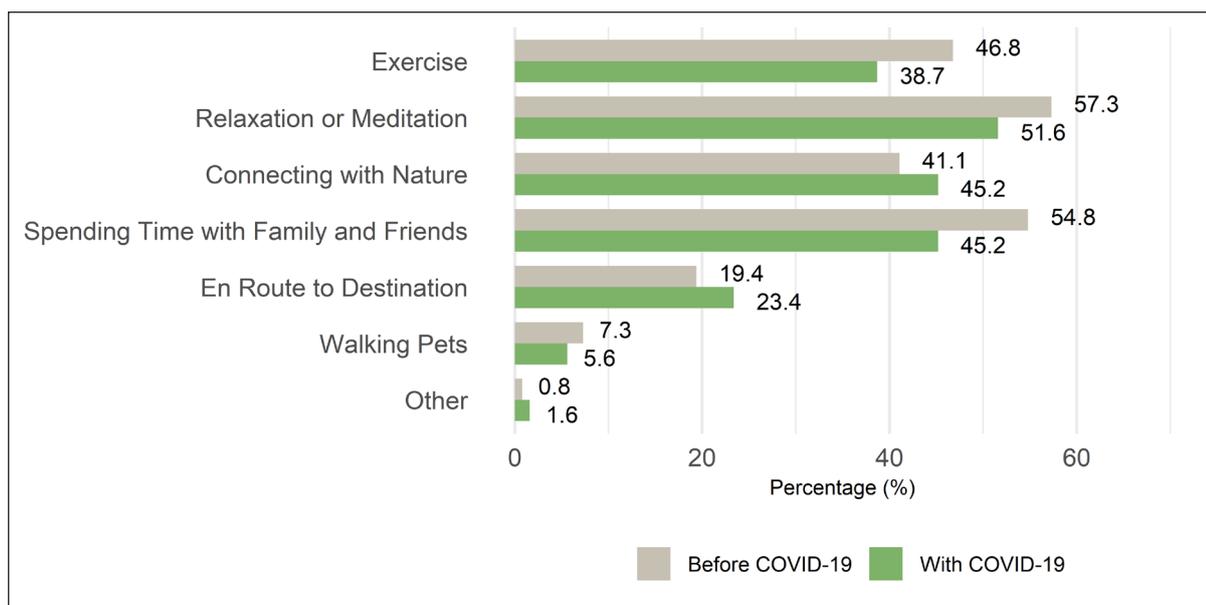


Figure 12. Reasons for using UGS before and during COVID-19 among respondents who reduced their visit to UGS

As Figure 13 demonstrates, respondents who reduced their visit to UGS after the outbreak of COVID-19 needed to use them as relatively safer replacements for other leisure activities or as a corridor to other places. Therefore, they were trying to intentionally reduce outdoor activities (78%) and avoid meeting family and friends (11%).

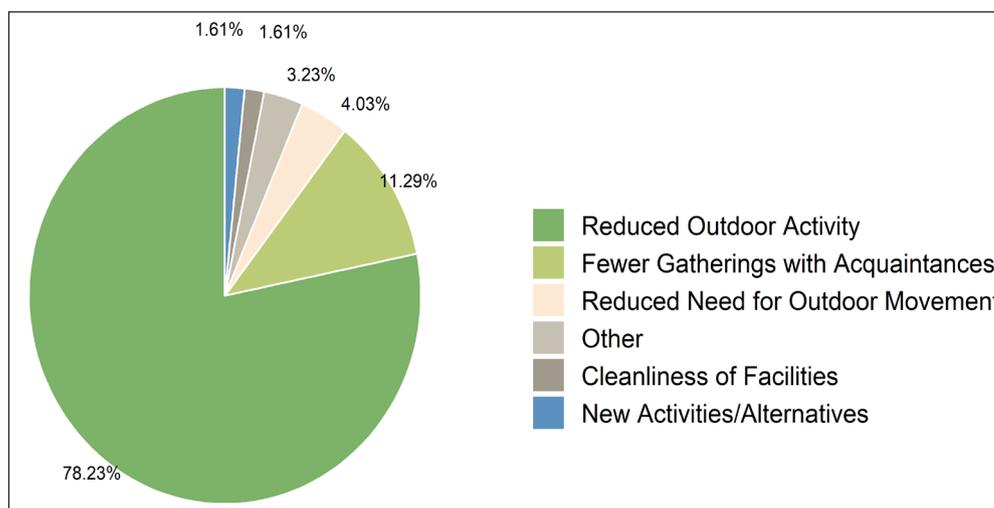


Figure 13. Reasons for reducing the use of UGS in the wake of Covid-19

In other words, the respondents changed their behavior as a response to COVID-19 restrictions and the need to observe social distancing and minimize contact with others (Uchiyama & Kohsaka., 2020). Their responses indicated that the use of UGS increased during their commutes as certain people preferred to walk instead of using public transportation. According to the Global Public Transport Report 2020, people in some cities no longer use public transport because of the pandemic (Moovit, 2021).

However, in case of Seoul, the trend seems to have started even before the pandemic. For example, the Seoul Metropolitan Government (SMG) analyzed about 296.5 billion traffic big data produced in 2019 and found that the total number of bus and subway use in 2019 was 3.4 billion, dropping down by 25.9% in 2020 (SMG, 2021a). In contrast, the total number of rentals of public bicycles from a bike-sharing system, *Ttareungi*⁶ rose by 24.6% to 23.7 million from 2019 to 2020. It appears that people preferred to walk or take a public bicycle rather than transferring for short distances (News1, 2021).

In Figures 14 and 15, the preferred transportation and time needed to visit UGS are shown. Most respondents said that walking was the best way to reach UGS (73.83%), and preferred UGS located within 30 minutes (72.9%) from their location. When looking at the results of Figure 14 disaggregated by age, other modes of transportation including public transportation accounted for the highest percentage of people in their 20s (about 18%), while the proportion of cars was highest for people in their 30s (about 16%) and 40s (about 12%). In addition as shown in Figure 15, the time required to visit UGS was preferred to be less than 30 minutes (about 73%) and less than 1 hour (about 18%).

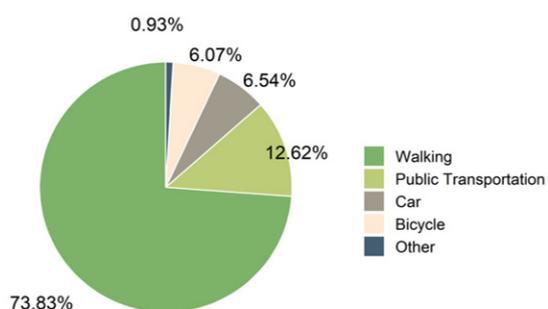


Figure 14. Preferred transportation to visit UGS

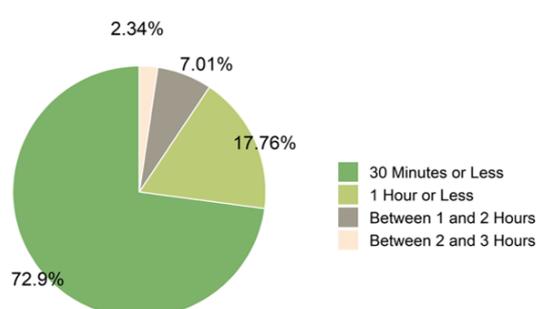


Figure 15. Preferred time needed to visit UGS

According to the survey results, Figure 16 and Figure 17 respectively show public opinion on facilities and services necessary to encourage usage of UGS. Facilities for rest and recreation such as outdoor chairs and benches (39%) were recorded as the highest priority, followed by natural “healing” or therapeutic facilities such as for forest-bathing (26%) and natural and cultural immersion facilities such as campsites or forest experience activities (17%) (Figure 16). In addition, the services required for the expansion of UGS were found in the following order: comfortable rest spaces (32%), tackling environmental issues (18%), health and well-being (16%) and increased biodiversity (12%) (Figure 17).

⁶ Ttareungi is an unmanned public bicycle rental service that began pilot operation in 2014 in Seoul and officially operated from October 2015 by the Seoul Metropolitan Government.

Using Urban Green Spaces in the Pandemic:
Example from the Republic of Korea

Based on these results, it can be inferred that to expand the use of UGS, creating a space based on pleasant and safe facilities should be a priority when improving or creating UGS. Also, considering that meeting environmental challenges was the second highest service that people want, people seem to already be aware that UGS play roles of mitigating the impact of environmental problems. Therefore, to create UGS as means of EbA, it is necessary to increase the use of UGS by creating a safe and healthy environment for both people and ecosystems rather than establishing other artificial facilities for aesthetic purpose.

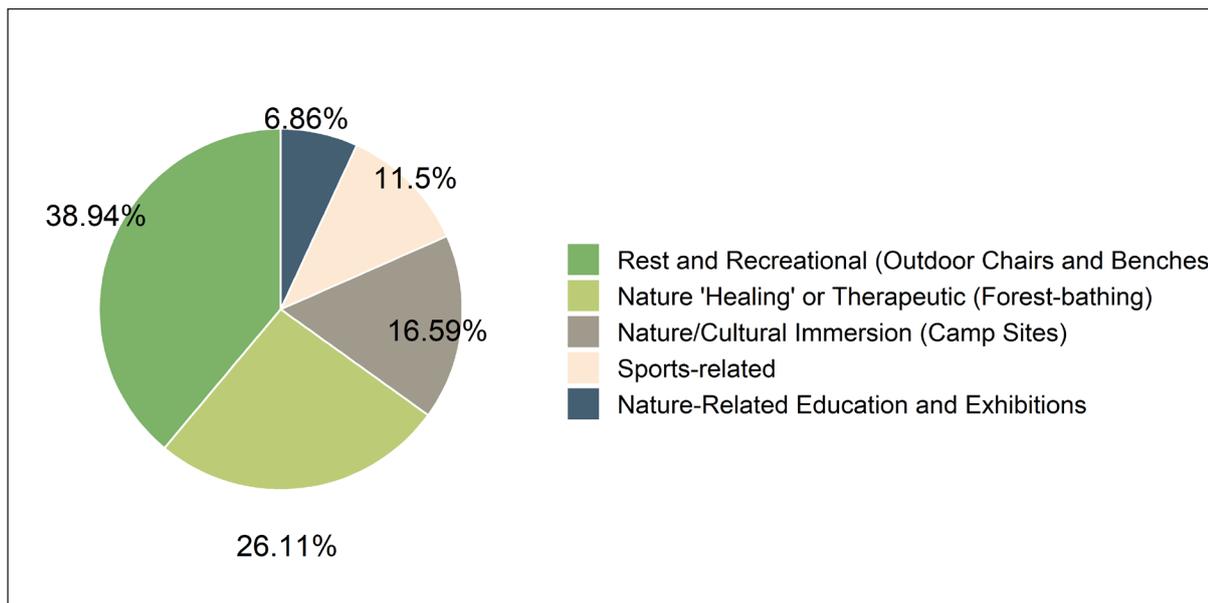


Figure 16. Facilities to encourage usage of UGS

2.3. Suggestions for expanding the use of UGS

Diversify the types of UGS

According to the survey results for this study, urban forests were considered the representative typology of UGS for most people. However, many people regarded rooftop gardens as UGS as well. According to the Architecture and Urban Research Institute (2020), external spaces such as rooftops have become widely used as a way to more actively utilize the architectural space and minimize the spread of infectious diseases. Therefore, the definitional range of UGS is expanding regardless of the size of green spaces. At the same time, with increasing demand for UGS, it is necessary for rooftop gardens, terraces and balconies in individual buildings be expanded after the spread of COVID-19 for increased accessibility. In this context, it is essential to diversify UGS outside and inside buildings through the utilization of rooftops and balconies.

Set a health policy using UGS

Urban quarantine policy including social distancing has resulted in various restrictions to people's behavior because they should keep a specific distance from others and avoid physical contact (Xie et al., 2020). The survey clearly demonstrates that people increased the use of UGS for physical or psychological health during social distancing. In addition, even when people reduced the use of UGS, some of them used UGS for health instead of other facilities like indoor gyms.

The survey also found that UGS could be used mostly as a 'space for health promotion' by people. In this context, it seems reasonable to include the utilization of UGS in connection with the government's overall health policy. This is especially relevant given that, the Ministry of Health and Welfare of Korea prepared a comprehensive plan to promote national health by building new public hospitals, improving the health insurance system, expanding the related budget, or strengthening cooperation with all ministries to promote health (MOHW, 2020). Similarly, in 2020, the Korea Forest Service (KFS) provided smart gardens⁷ in public health institutions for forest healing in cooperation with the Ministry of the Interior and Safety and the Ministry of Health and Welfare of Korea. To strengthen the linkages between public healthcare policy and UGS, more research is needed. This research can explore more in-depth health implications including relief of stress through green spaces that can support the development of health policies.

⁷ 'Smart Garden' is a new concept garden system which is able to monitor the temperature and humidity, control irrigation, lighting, air quality and soil moisture automatically (Song, 2020). It is a suitable and sustainable method for urban helping more accurate, organized, effective and scientific greening management (Wang & Zhang, 2021).

Although we can find several research on urban spatial structure that consider improving health of low-income groups and vulnerable groups including children and elderly people in Korea (Lim et al., 2009, Bae and Kim, 2013), there is still a need for more specific and intensive research analyzing the relationship between public health and UGS, and suggesting ways to promote or utilize it.

Provide cultural services with better accessibility

The result of the survey shows that people prefer to visit UGS on foot and within a short distance from their residence. Earlier studies such as Schipperijna et al. (2010) report that the shorter the distance, the more frequent the use of UGS – with more than half of residents in the study using UGS living within 300m. Insufficient greenery, including, lack of recreational infrastructure and abandoned green spaces limit citizen's utilization of green areas (Ponizy et al., 2017). Meanwhile, Daniel et al. (2012) suggested better integration of cultural services with heritage, outdoor recreation, landscape aesthetics among other factors to gather people at UGS. It means that people enjoy experiencing cultural activities in conjunction with green spaces. In New York city, social interaction, recreation and community projects in UGS provide numerous benefits in terms of cultural exposure and gathering citizens to green spaces.

In line with the results of this survey, UGS can be enlarged with a detailed assessment of: demands including distance to UGS from residences; cultural factors for attracting people; linkages between green spaces using bicycles and user-friendly road for bikers and pedestrians. In Seoul, for example, there are various forest trails. In particular, in the case of the *Gyeongchun* subway line forest trail, sometimes classical music attracts people's attention at a certain time. It provides further comfort to visitors in addition to the nature experience. Furthermore, creating UGS near cultural spaces such as museums, exhibition centers, art centers can support people's cultural life in synergy with nature. For example, *Hanbat* Arboretum, located in the city of Daejeon, has a leisure and cultural life space next to it including the city's Arts Center, Museum of Art, a *Korean Traditional Music Center*, Expo Plaza, among other facilities. People can enjoy culture, art, and sports at the same time. This kind of UGS strategies can further improve the quality of life of citizens.

3. USING URBAN GREEN SPACE DURING THE COVID-19 PANDEMIC

3.1. Lessons from the Korean response to COVID-19

The survey covered in chapter 2 demonstrates an increasing awareness about the importance of UGS due to the COVID-19 context. Hence, chapter 3 will explore some notable examples of UGS in Korea. Overall, Korea has proven to be one of the most successful countries in its preparation and handling of COVID-19 along with Germany, Switzerland and New Zealand. According to Forbes, in June 2020, Korea was ranked as the 10th safest country globally for COVID-19 (Koetsier, 2020a). The study used 130 qualitative and quantitative criteria such as the effectiveness of social distancing, monitoring and government capacity to manage the disease.

Furthermore, in September 2020, the study was updated, and Korea ranked as the 3rd safest country in the world for COVID-19 (Koetsier, 2020b). Korea was well-prepared for the pandemic as highlighted by the '2019 Global Health Security Index', which evaluates the capability to manage infectious disease using six categories: Prevention, Detection and Reporting, Rapid Response, Health system, Compliance with International Norms, and Risk environment. The report gave Korea a 70.2 index score and ranked the country 9th out of 195 countries, while the world average index score was 40.2 (NTI and Johns Hopkins Center for Health Security, 2019).

The Success of Korea with prevention policies was a product of several factors. You (2020) listed five elements behind the success story of Korea. The first element is the national policy for disease. The Korean government prepared a manual on how the government, especially the Korea Centers for Disease Control and Prevention, should respond during outbreaks. Also, the manual allows for flexibility in policy response during disaster situations. The second element is Public-private partnerships that detect and help control disasters. The third element is related to sharing of information that supports contact tracing. The fourth is the adaptive capacity of the health care system and the last element is trust within society. These five factors have made Korea one of the safest countries against COVID-19. Additionally, Korea attempted to overcome the corona blues (COVID fatigue) through expanded UGS. Song et al. (2019) researched the relationship between UGS and depression. Their research showed that people near abundant UGS were 18.7% less likely to suffer some degree of depression than people who were not near them. This chapter introduces specific examples of UGS as a breakthrough in relieving depression during the pandemic era.

3.2. Korean case of adapting UGS to deal with COVID-19

3.2.1. Parks and urban forests

Hyde Park in London and Central Park in New York were established in the mid-19th century to solve issues such as pollution, noise and stress levels among workers in industrial cities (Lee, 2020). Urban parks are also utilized as areas to solve social problems and create new values through community exchanges. In particular, urban parks act as an alternative space for public health and epidemic prevention. In Korea, during COVID-19, we investigated cases in which parks and urban forests were used as alternative spaces and as an EbA approach to address COVID-19.

Boramae Park

From August to December 2020, the Eastern Office of Parks and Management in Seoul operated a socially distanced programme based on ideas selected from an idea contest. The competition and programme were held to promote the usage of parks among citizens during COVID-19. The programme aimed to use ideas from the public to promote the safe and healthy use of UGS. There were two themes outlined in the contest: 'My own way to avoid COVID-19' and 'Ways to enjoy the park that everyone can use in a healthy and happy manner in the post-corona era'. A total of 319 ideas were received, and after expert screening, 42 winners were selected.

'*Boramae Park Sseudam Sseudam*'⁸ is a park tour programme that includes volunteer activities in which 13 out of 42 winners of the contest participated. For a litter picking activity, participants received packages with garbage bags and gloves, as well as community service hours (Figure 19). After participating in the program, if participants posted photos of their experience on social media, goods from Boramae Park were provided as prizes.

⁸ 'Sseudam Sseudam' is a mimetic word in Korean meaning 'to stroke one's head'. In this programme the word also means 'to put the trash away' and 'to clean up the environment.'

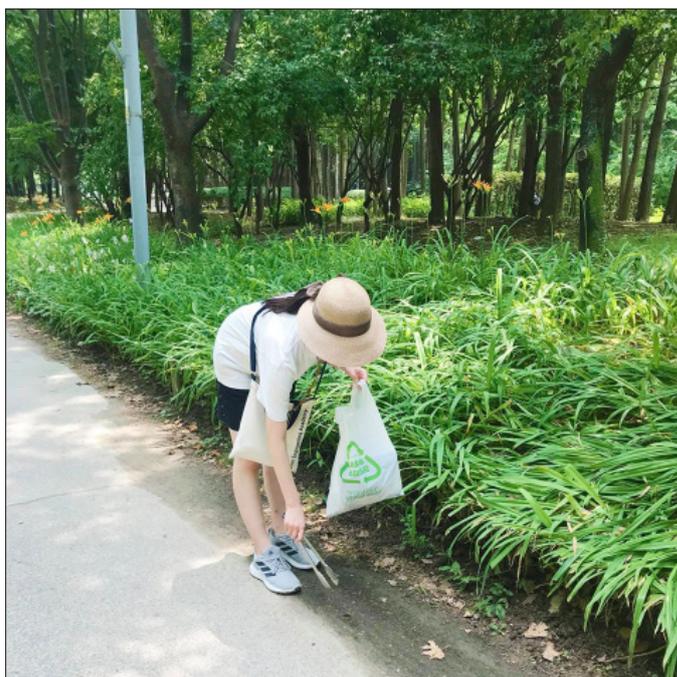


Figure 19. Photo from ‘Boramae Park Sseudam Sseudam’
Source: Kim, 2020

Seoul Forest Park

The Seoul Green Trust is a non-profit foundation that expands and preserves green spaces in Seoul's living area and creates a pleasant urban environment based on citizen participation. Currently, it has undertaken various activities to improve citizens' awareness of city parks. It also focuses on protecting green areas by managing Seoul Forest Park, organizing academic events and promoting urban forests and city parks through volunteers.

Seoul Green Trust held various events to encourage citizens to use the parks wisely during the pandemic. They adapted volunteer activities to comply with COVID-19 restrictions. This included four types of socially distanced volunteer activities such as 'making eco-friendly fertilizers', 'making park etiquette signs,' 'Seoul Forest Garbage Collection' and 'picking up weeds'.

Additionally, the “Blue in you, Green in park” event was held on 13 November 2020 in Seoul Forest Park. This event proposed to improve the health of parks and people. The event aimed to counter the feelings of corona blues (COVID fatigue) experienced among the public through the green space that parks provide. Furthermore, seven programmes under the theme of ‘Zero Waste, Zero Stress, and Zero Corona’ were conducted, with the participation of 1,321 citizens. All programmes were organized in a socially distanced manner. In particular, the ‘Zero Corona’ programme ran campaigns to

put hand sanitizers and disinfectant tissues throughout the park for citizens to use, and to make mask necklaces for themselves.

Green space in Mapo-gu⁹

Mapo-gu in Seoul held an event with public participation called 'Relay Tree Planting' on April 9, 2021, which is Arbor Day¹⁰ in Korea. To comply with COVID-19 restrictions, small groups of people planted trees in a relay format throughout the region – from 'Ahyeon Greenery' located in the eastern end of Mapo-gu, to the Gyeongui Line Forest Road by Sogang University Station, Danginri Power Plant Park and Sangam Mountain in the western end. A total of eight locations were visited for planting at an hourly interval. A total of 5,500 plants were planted that day, including giant oak, ivy, shrubs such as arrowheads, and flowers such as sorghum, pansy and hydrangea.

Seo-gu Greenway in Daegu Metropolitan City

The Seo-gu Greenway in Daegu Metropolitan City is a walking trail built with an investment of around \$5 million from 2017 to 2020. It is a 6.2 km trail linking the Seodaegu Industrial Complex Buffer Green Zone and Ihyeon Park. During its construction, an old walking trail was repaired, and a rose garden, photo zones and various convenience facilities were installed. It was established as part of an eco-friendly green project to improve the health and quality of life among residents by reflecting the rapidly growing demand for “green healing” by park users (Daegu Metropolitan Government, 2020).

Seo-gu Greenway extends and expands green spaces around the Seodaegu Industrial Complex that emits a significant amount of air pollutants. The aim of creating urban forests here is to block fine dust and alleviate the impact of the heat island effect and heat waves (Daegu Metropolitan Government, 2020). These efforts have improved the health of residents near the industrial complex and improved their quality of life and living conditions by planting various trees and creating forests.

The Seo-gu Greenway, in particular, offers benefits to residents in the COVID-19 era. Due to social distancing, instances of depression or lethargy have increased. Open green spaces allow residents to socially distance while participating in healthy activities such as walking or simple exercise in open green spaces.

⁹ 'Gu' is a unit to refer to districts or boroughs in metropolitan cities in Korea.

¹⁰ National Arbor Day (April 5th) is the designated day for planting trees. Each administrative agency, school, and organization set a reforestation goal.

3.2.2. National parks

A national park in Korea usually has pristine environmental and scenic conditions and is an important national resource. As the preeminent recreational resource in Korea, it has high ecological value and is an important area that provides recreational opportunities to urban residents (Sim and Lee, 2010). National parks are designated by the Minister of Environment in accordance with the Natural Parks Act, which determines whether a place can represent the natural ecosystem and cultural landscape of Korea. Currently, there are 22 designated national parks in Korea which are managed by the Korea National Park Service (KNPS). Given that 63% of land area in Korea is made up of forests, there are many basins around cities surrounded by mountains (Song and Park, 2013). Therefore, in this paper, national parks such as Bukhansan National Park and Gyeryonsan National Park are highly accessible from cities, they are regarded as UGS.

The KNPS announced that from January to June 2020, the number of visitors to three national parks near downtown areas: Bukhansan National Park (Seoul Metropolitan area), Gyeryongsan National Park (Daejeon Metropolitan City) and Chiaksan National Park (Wonju City), increased by about 21% on average compared to the previous year (KNPS, 2020). The number of visitors to Bukhansan National Park recorded 3.41 million in the first half of 2020, increasing by 23.5% from 2.76 million in the previous year. The number of visitors to Gyeryongsan National Park increased by 15.6% to 1,042,199, and the number of visitors to Chiaksan National Park increased by 23.8% to 406,747. The number of visitors to Jirisan National Park slightly increased by 4.8% from the previous year to 1,225,764 (Ministry of Culture, Sports and Tourism, 2020).

The KNPS has created programmes to allow people to relax in national parks during COVID-19. Special programmes such as a tour of Jirisan mountain with fathers, bird watching and constellation observation have been carried out. They have also organized healing programmes to provide eco-friendly experiences, including walking in forests and observing animals and plants in natural parks for children and families with environmental diseases¹¹ (Won, 2020). In the case of Gyeryongsan National Park with the Small Enterprise And Market Service, a division of the Ministry of SMEs and Startups, an ecological tour programme was organized for small enterprises to encourage them to overcome COVID-19 related fatigue (Jeong, 2020). The KNPS guides visitors through the rules for preventing COVID-19, such as wearing masks, walking in a line and sitting away from crowded places for safe national park exploration.

¹¹ Environmental diseases are determined by environmental factors that can be related to personal lifestyle (smoking, alcohol/substance abuse, abnormal eating patterns), physical factors from the environment (UV radiation, cold, heat, air pressure, electricity) or exposure the irritant or toxic chemicals from the environment (heavy metals, halogens, organic compounds, or noxious gases) (Hostiuc, 2018).

3.2.3. Public indoor gardens

As shown in chapter 2 section 2.2, citizens considered outdoor green spaces and the indoor gardens or gardens in building as UGS. In other words, green areas and ecological areas that can be easily accessed in cities are identified as UGS. Therefore, in this paper, public indoor gardens are presented as cases that helped residents cope with COVID-19.

The Korea Forest Service (KFS) conducted a Profile of Mood States (POMS) Questionnaire¹² to examine indoor gardens' healing and relaxation effects. It investigated changes in mood 10 minutes before and after experiencing indoor gardens among 50 college students and workers living in Seoul, who were judged to be sufficiently fatigued. They expressed decreased psychological stress as well as reductions in tension, anxiety, fatigue, helplessness and depression after experiencing the indoor garden (Table 8).

Table 8. The results of Profile of Mood States Questionnaire
Source: Korea Forest Service, 2018

Item	Before experience	After experience
Tense-Anxious	11.64	9.02
Discouraged	9.7	7.58
Angry-Helpless	9.34	6.84
Vigorous	14.68	15.48
Fatigued	11.2	8.5
Confused	11.92	9.74

With this finding, in 2020, the Seoul Metropolitan Government (SMG) started to foster smart gardens by planting 4,766 seeds of 15 types of indoor plants in 5 public and medical institutions, as well as 6 underutilized areas covering a total of 130.87m² (SMG, 2021b). In line with the SMG, the city of Cheongju built a 290m² vertical garden and a 20m² horizontal garden at Cheongju International Airport in 2021 to improve indoor air quality and provide a green resting space for users during and after COVID-19 (Cheongju Metropolitan Government, 2021).

The Seoul Botanical Park officially opened in May 2019. Based on the visitor status report published by the Park, the number of visitors to the Seoul Botanic Park has increased rapidly since April 2020 (Figure 19).

The Seoul Botanical Park provides a variety of experiences and educational programmes related to gardening. In this context, the Seoul Botanical Garden plays an

¹² The POMS is a standard validated psychological test formulated by McNair et al. (1971). It contains 65 self-report items using the 5-point Likert Scale and assesses short-term mood states which are understood to be transient and frequently fluctuating.

important role as a place to relieve symptoms of corona blues. The garden can also be a potential asset in response to another pandemic and climate change, going beyond the role of the traditional gardens that aim to protect plants and exhibit them.

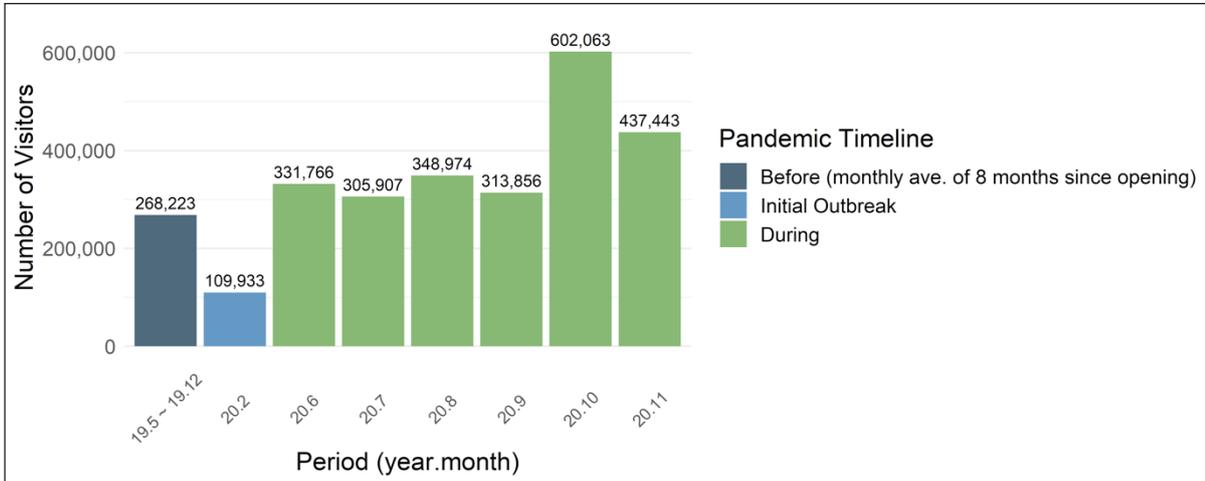


Figure 20. The number of visitors to the Seoul Botanical Gardens since its official opening
 Source: Seoul Information Communication Plaza, 2020

3.3. Government plans for UGS post COVID-19

The ‘COVID-19 Community Mobility Report’ published by Google discussed in section 2.1 of this paper revealed differences in the life patterns of people before and during COVID-19. This included closed areas and open areas based on changing governmental guidelines. Google’s report demonstrated the increase in UGS use by residents during the pandemic.

The survey done for this study (Annex) shows that awareness UGS has recently increased. However, there was a significant amount of awareness about the importance of green spaces in Seoul even before the pandemic due to their recognition as popular rest places that offer protection from air pollution, specifically from PM_{2.5} and yellow dust (KEI, 2019). They also help to relieve the heat island effect¹³ in urban areas. Given these benefits, central and local governments have tried to formulate plans and strategies to expand and utilize UGS. The role of governments is essential to construct UGS. The central government tends to formulate master plans while local governments search for appropriate areas and manage the construction of green spaces. Different levels of government should cooperate to effectively plan and construct UGS. This part of the paper will describe future plans and strategies suggested by the central and local governments for UGS.

¹³ Heat island effect means that a city, which has many skyscrapers and buildings, retains more heat and high temperatures compared to suburban areas.

The first section will provide the central government's plans for post-COVID-19, including plans from the Ministry of Environment and KFS. The second section will focus on local government projects at the provincial and municipal levels.

3.3.1. The central government

KFS designed the 'second urban green master plan' in 2019 (KFS, 2019) (Figure 20). The ten-year master plan will be continue to be implemented from 2018 to 2027. The plan highlights the degradation of UGS due to rapid industrialization and urbanization. Based on this, the plan assumes that there will be an increase in the demand for UGS due to environmental pollution such as fine dust. The plan also expands on the social and economic effects of UGS. Therefore, it is essential to set up a master plan for building and managing UGS. Before initiating the second master plan, KFS reviewed and analyzed the 'first urban green master plan.' Then, it set up five primary strategies to achieve 15m² of UGS in the life zone¹⁴ per capita by 2027.

The first strategy is to establish an urban green network system. The strategy contains two major works: establishing the system of constructing and managing urban greenery and expanding the urban green network. The objective is to set up a system of UGS and to extend the established network.

The second strategy is to enlarge UGS. The second strategy has four major parts: To expand urban greenery, afforest along streets, build and manage a meditation forest systematically and enlarge village and landscape forests. The aim is to increase the number of meditation forests to 2,659 in 2027 from 1,659 in 2017, extend the scale of trees along streets to 50,000 km from 42,552 km and enlarge the UGS to 7,000 ha from 4,516 ha.

The third strategy is to improve the quality of UGS. The third strategy consists of managing the landscape to improve the urban scenery and enhancing the quality of trees along streets. The objective of the third strategy is to develop and operate indicators for managing urban forests and suggest a management system for trees along streets for providing their quality.

The fourth strategy is to promote the utilization of UGS. The strategy is composed of three major objectives: Promoting visits to UGS, utilizing green spaces as a forest welfare service and using forests to create jobs and business places. The objective is to promote the forest welfare service and create jobs using UGS in residential zones.

¹⁴ Life zone means a zone where people engage in everyday activities such as working, studying, shopping and enjoying their free time.

Using Urban Green Spaces in the Pandemic:
Example from the Republic of Korea

The last strategy is to establish the foundation to construct and manage sustainable UGS. The fifth strategy contains two major works: encouraging private sector involvement and improving related legislations and systems. The aim is to prepare the system and institutions to maintain sustainable UGS.



Figure 21. The First and Second Urban Green Space Master Plans
Source: Korea Forest Service, 2008 and 2019.

3.3.2. The local government

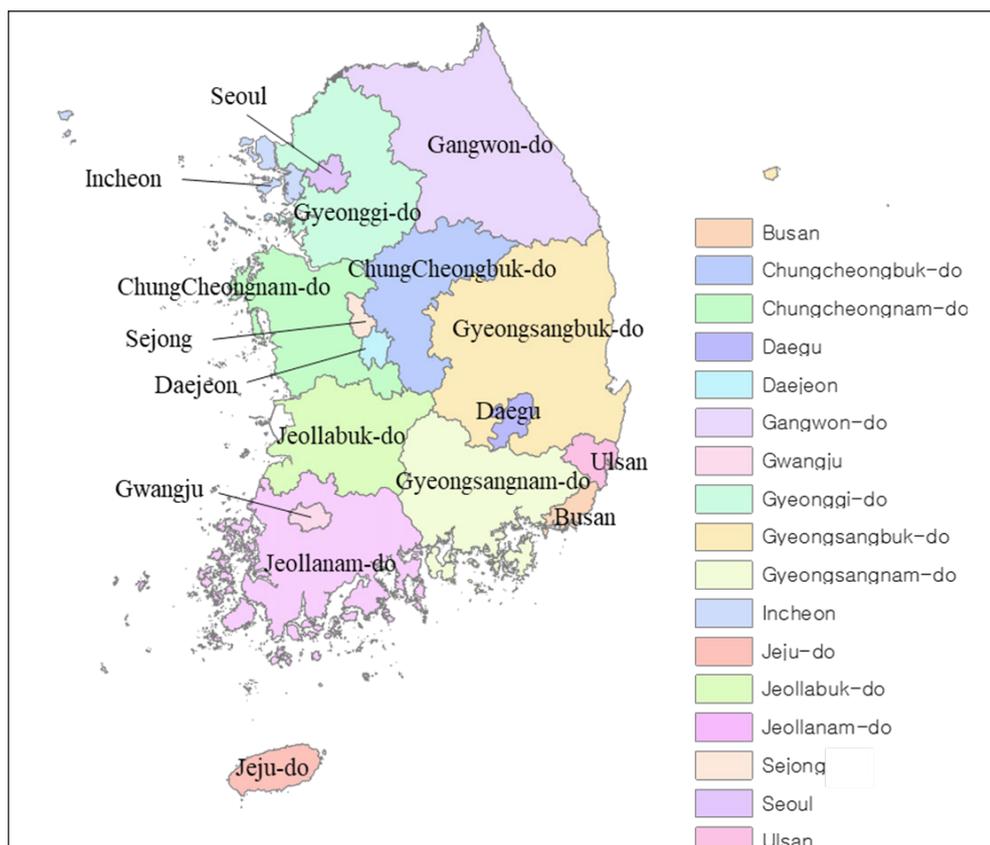


Figure 22. Administrative districts in Korea
Source: Authors, Korea University

Provincial and municipal governments mainly approach the expansion and improvement of UGS in two ways: regulations or guidelines, and projects with spending budgets.

- Regulations and guidelines:
 - Gyeonggi-do’s ‘Construction and Management of Urban Forests and Other Green Spaces in Gyeonggi-do’.
 - Chuncheon City’s master plan and guidelines for urban green space for the next hundred years
- The purpose of projects:
 - Forests for relaxation purposes and resident well-being, windways¹⁵, blocking fine dust and kids’ safety¹⁶

¹⁵ Windways attract clean and fresh air from the outskirts of urban areas into a city to circulate the air and push heat and pollutants out of the city.

¹⁶ Urban green spaces, especially trees, around school zones help prevent car accidents by blocking cars on the sidewalk.

3.3.2.1. Provincial Government

Korea consists of nine provinces: Gyeonggi-do, Gangwon-do, Chungcheongbuk-do, Chungcheongnam-do, Jeollabuk-do, Jeollanam-do, Gyeongsangbuk-do, Gyeongsangnam-do and Jeju-do. This section describes each provincial government's project plans and budget for constructing UGS.

Gyeonggi-do

Gyeonggi-do is located around the capital city, Seoul. A large part of the Korean population lives in Gyeonggi-do, with approximately 13.74 million living there, based on June 2020 data. It was found that citizens were not satisfied with the green infrastructure in the province (KFS, 2021a). Information provided by Statistics Korea, illustrated that Gyeonggi-do's urban green area per capita was ranked comparatively low to other provinces (Table 10). Therefore, the provincial government enacted and executed a regulation, 'Construction and Management of Urban Forests and Other Green Spaces in Gyeonggi-do' in March 2019. It was a significant development given that this was the first regulation related to UGS at the local government level and provided a legal basis to build the systematic background for sustainable management of urban forests (Gyeonggi Assembly, 2021; Gyeonggi Provincial Government, 2018). The regulation was enacted in June 2020 and executed in June 2021. The provincial government has been trying to set up a plan and implement projects based on its provincial regulation.

In addition, Gyeonggi-do aims to implement the 'Green New Deal model for Gyeonggi-do', which is associated with the 'Korean New Deal' policy and regional development in 2021. The 'Green New Deal model for Gyeonggi-do' includes low-carbon public transportation, green remodeling and public forests with a total budget of about \$37 million. In particular, the master plan includes building 376 sites for urban forests, which include planting trees along streets and around schools, creating small-medium-sized parks and industrial complexes (Hong, 2020). Furthermore, the provincial government set an additional strategy to service 11m² of UGS per capita by 2027 to prevent air pollution such as fine dust. In 2019, Gyeonggi-do built a forest to block out fine dust in Pyeongtaek industrial complex. KFS awarded this forest a grand prize on '2020 best practice for green city to prevent fine dust'. Based on the experience, Gyeonggi-do will be constructing five more forest sites in the following cities: Ansan, Hwaseong, Anseong- and Pyeongtaek, amounting to 7.43ha (Lee, 2020).

Table 9. Urban green area per capita by province (unit: m²)
Source: Korea Forest Service, 2021b

Province	2017	2019
Gyeonggi-do	112.11	119.66
Gyeongsangnam-do	265.20	272.99
Jeollabuk-do	298.26	336.90
Chungcheongnam-do	427.13	450.63
Chungcheongbuk-do	648.30	592.84
Jeju-do	1,413.87	666.02
Gyeongsangbuk-do	794.71	790.30
Jeollanam-do	878.07	852.67
Gangwon-do	2,359.91	2,548.83

Gangwon-do

Gangwon-do ranks high in satisfaction levels regarding the forest environment over the past decade (Table 11¹⁷). Furthermore, the rate of urban green area per capita as provided by Statistics Korea is the highest in the country (Table 10). The provincial government has researched and implemented plans to build UGS. Under the provincial government's guidance, projects were executed at the municipal level. For example, Chuncheon City has selected 300,000 trees to be planted along the streets based on recommendations from the urban forest committee from 2018 to 2020. The selection was based on the suitability of the surrounding environment such as soil and exposure to sunlight (Hwang, 2021).

Additionally, Chuncheon City is designing a long-term master plan for UGS, including guidelines for the next hundred years. The master plan is currently at the research stage. The purpose of the research is to suggest the future vision of urban forest in Chuncheon City and construct and manage green infrastructure in sustainable ways. The study will comprehensively analyze the status and conditions of forests, related policies and projects from Chuncheon, looking at different levels of government and different institutions (Hwang, 2020). Gangwon University is leading the research for the master plan, and it will be completed by July 2021.

Wonju is another city in Gangwon-do; it plans to improve and maintain its urban parks and grow a greener environment. The total green area amounts to 2.7 million m², including 107 parks and 114 green regions. The project is systematically managed to improve the seasonal growing environment, grow seasonal flowers reflecting specific

¹⁷ As a measure of satisfaction with forested environments, this survey considers the proportion of residents replying to the quality of UGS and rural green spaces in their province as either 'good' or 'excellent'.

characteristics of each city park, and planting trees along streets based on the type of species suitable to the surrounding atmosphere (Jeong, 2021).

Table 10. The percentage of satisfaction with forested environments by province, 2010-2018 (unit: %)
Source: Statistics Korea 2021

Province	2010	2012	2014	2016	2018
Jeollabuk-do	50.0	58.4	51.0	45.6	45.1
Chungcheongbuk-do	42.3	44.9	46.5	41.4	49.6
Gyeonggi-do	44.1	44.6	41.0	44.5	50.6
Chungcheongnam-do	58.4	49.6	42.8	38.3	53.2
Jeju-do	57.8	57.0	51.4	44.5	56.1
Gyeongsangbuk-do	52.3	51.5	48.7	47.8	59.1
Gyeongsangnam-do	51.1	51.1	49.7	42.4	60.7
Gangwon-do	54.9	59.9	52.8	52.0	67.0
Jeollanam-do	58.4	58.2	54.0	47.1	68.7

Chungcheongbuk-do and Chungcheongnam-do

Chungcheongbuk-do (shortened as Chungbuk) spent \$2 million to afforest 15 urban areas in 2020 and 15 urban forests with a budget of \$4 million in 2019 (Chungbuk Provincial Government, 2020). In 2021, the Chungbuk government will spend about \$19 million on constructing 31 forests to reduce fine dust, alleviate the heat island effect and provide rest places to improve living environments. The major projects consist of four aspects: forests for windways, blocking out fine dust, kids' safety and UGS. The forest for windways connects the suburbs and the urban forest areas costing about \$88 million in Jeungpyeong-gun.

In addition, forests will be added to block out fine dust in each green area in Cheongju City, Chungju City, Jincheon and Eumgseong counties with a project budget of \$6.5 million. The forest for kids' safety will be constructed in 4 areas within Cheongju City and Jecheon City, with a budget of \$0.7 million to secure traffic safety and improve air quality. Lastly, the urban forests will be established in 22 areas in nine different regions with a budget of \$2.9 million (Chungbuk Provincial Government, 2021).

Chungcheongnam-do (shortened as Chungnam) has set a five year master plan named 'Afforestation for a better life to improve air quality and the living environment'. The master plan is scheduled to be implemented from 2021 to 2025, and the total budget amounts to \$0.1 billion. On the basis of the master plan, the Chungnam provincial government will spend \$31 million on expanding green infrastructure, including forests, to block out fine dust. The project will also aim to increase accessibility to green areas

for residents. The major aspects of the plan include building 200 forests around living areas, 12 urban green areas, 60 meditation forests, hiring 500 employees to manage urban forests, and planting 548 km trees along the streets. Specifically, it contains 14 forests to block out fine dust, 12 citizen customized green areas, 10 urban forests, 5 hometown forests and one windway. To prevent the expansion of fine dust and improve air quality, forests will be planted strategically near emission sources such as aging industrial complexes. Both citizen customized green areas and hometown forests could afforest green spaces around residential areas in line with local characteristics. Finally, the urban forests project aims to expand green space in urban areas to increase accessibility, alleviate the heat island effect and improve the landscape (Ha, 2020; Lee, 2021).

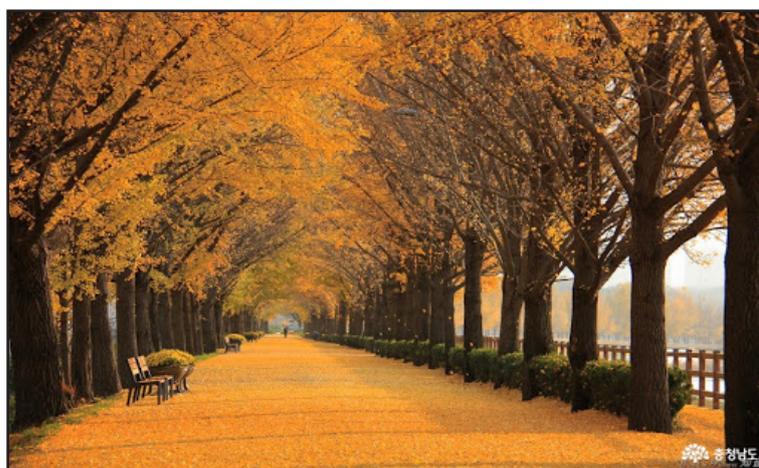


Figure 23. A ginkgo tree road in Chungcheonnam-do
Source: Ha, 2020 (courtesy Chungnam Provincial Government)

Jeollabuk-do and Jeollanam-do

The government of Jelloabuk-do plans to expand UGS around settlement zones in response to the corona blues and fine dust. The project suggested by the provincial government will spend \$13,000 to afforest 19.2 ha small-sized areas, plant trees along 33.2 km of streets, establish 19 school forests and eight village green spaces to improve accessibility to UGS. Furthermore, other forests projects aimed at reducing fine dust and ensuring kids' safety will be implemented. For these projects, approximately a budget of \$9.5 million has been secured through the central government's 'Green New Deal' policy to manage environmental problems and overcome the economic crisis caused by COVID-19. The provincial government will spend \$18 million on building 11 urban forests including in Jeonju City. The forest for kids' safety was first introduced to prevent traffic accidents through eco-environmental ways in children protection zones. It secures safety in school zones by planting trees between the walkways and roadways. Jeollabuk-do will spend \$0.44 million to implement projects in Iksan City, Gimje City and Buan County. Lastly, the provincial government will afforest the windways on Baekje-

main street in Jeonju City by 2022 to circulate air within the city and expel hot and polluted air while pulling in clean air (Jeonbuk Provincial Government, 2021).

Jeollanam-do, over the last two years, has afforested 24.4 ha to block out fine dust with a budget of \$22 million. The target areas were 14 regions, including the cities of Yeosu, Gwangyang, Mokpo and Suncheon. This year, the provincial government is determined to spend \$31 million on afforestation. These forests will play an important role in providing clean air and controlling fine dust from industrial complexes and highways into residential zones. The project area is 12 regions made up of 37 ha such as 2 ha Mokpo, 7 ha Yeosu, 7 ha Suncheon, 7 ha Gwangyang, 3 ha Gokseong, and 2 ha Boseong. The project is expected to decrease 6.2t equivalent of atmospheric pollutants. Jeollanam-do has consulted with experts on tree species and planting methods to move forward (Ministry of Environment, 2021).

Gyeongsangbuk-do and Gyeongsangnam-do

Gyeongsangbuk-do (commonly called Gyeongbuk) has been investing in UGS since 2019. In 2019, the provincial government afforested 41 ha of urban forest and 82 km of trees along streets with a budget of \$25 million (Seo, 2019). In 2020, Gyeongbuk spent \$26 million on building green areas (Kim, 2019). In 2021, the afforestation project in Gyeongbuk will be implemented with funding from the central government's 'Green New Deal' policy with a budget of \$20.5 million (Son, 2020).

Gyeongsangnam-do (commonly called Gyeongnam) is planning for post-COVID-19 forest recreation facilities. Gyeongnam will spend around \$36.4 million on green infrastructure to provide better environmental services. The budget will be utilized for several projects such as building and upgrading 13 recreational forests and three healing forests as well as maintaining forest parks. Despite COVID-19 restrictions limiting the use of green spaces, the provincial government expects the demand for green spaces to increase after the pandemic as residents search for stress relief (Gyeongnam Provincial Government, 2021).

Jeju-do

Despite Jeju-do's reputation as a green island, it does not have enough UGS. The urban green area per capita in Jeju island more than halved from 2017 to 2019 (Table 10). However, Jeju City tried to expand its green spaces. For instance, it spent \$18 million on building UGS in 2020 (Jwa, 2020). In 2021, the Jeju City municipal government will construct urban gardens by planting cosmos flowers in an area of 15,000m². The provincial government expects to provide environmental services for the commercial district (Jeju City Hall, 2021).

Furthermore, the provincial government will spend \$51 million on forestry and green sectors in 2021. The budget for this year increased by 7.6% (\$0.4 million), more than the \$47.1 million in 2020. The increased budget concentrates on afforestation to mitigate greenhouse gases by creating windways, promoting the basement of forest management and increasing the incomes of forestry employees. The objective of the project is to expand carbon sinks in the forests in Jeju island, improve quality of life through greening urban spaces, increasing the income from forestry and prevent forest disasters such as forest fires (Jeju Provincial Government, 2020).

3.3.2.2. Municipal Government

Korea consists of eight major metropolitan cities: Seoul, Busan, Daegu, Incheon, Gwangju, Daejeon, Ulsan and Sejong. These municipal governments are separate administrative units from provincial governments.

Seoul

Seoul is the capital city of Korea and surrounds the Han River. The city has a lot of potential for UGS. However, the urban green area per capita is the lowest out of all the major metropolitan cities in Korea and even thirtyfold less than the city ranked first, Ulsan (Table 11). A major problem in Seoul is its high population density. The population of Seoul is about 9.8 million, but the area is only 605.2 km², accounting for 0.6% of the total land of Korea. However, the ratio of satisfaction for the forest environment in Seoul has gradually increased (Table 12) with the steady expansion of UGS.

In this context, Seoul will construct windways in cooperation with KFS with a budget of \$15 million. The windways would afforest roads and streams by connecting the suburbs to Gwanak Mountain and Bukhan Mountain. The linked forests will result in air circulation by pushing cool air into the suburbs. There are three types of windways: directing clean air from forest to urban areas, connecting between forest and urban areas, and constructing parks, green roofs and walls. The connecting forest completes the green axis by planting 51 km, 101,443 m² around streams and streets. The directing forest creates windways through afforestation and management. Lastly, these parks, green roofs and green walls make-up a small-sized forest, thereby creating a breeze due to the temperature difference. The municipal government expects to circulate air, improve air quality, alleviate fine dust and heat island effect and establish comfortable and convenient green environments. (SMG, 2020).

Table 11. Urban green area per capita by metropolitan city (unit: m²)
Source: Korea Forest Service, 2021b

City	2017	2019
Seoul	14.91	18.53
Incheon	47.48	49.25
Sejong	54.90	51.51
Busan	84.73	91.15
Gwangju	124.57	129.08
Daegu	119.11	150.36
Daejeon	164.70	189.18
Ulsan	297.31	332.26

Busan

The ‘Satisfaction with Forested Environment’ survey¹⁸ illustrated that resident satisfaction with the forested environment in Busan from 2010 to 2018 has gradually increased (Table 12). In 2020, Busan designed the ‘Busan, City of Forest’ project that spent \$74 million on 129 projects classified into three models: forest for the environment, life and ecology. The strategies provided benefits such as improving air quality, alleviating the heat island effect and supporting the local economy, which has slowed down due to COVID-19. The budget of environmental forest projects amounted to \$2.2 million to afforest UGS and reduce fine dust. The life forest projects aimed to plant trees on empty sections of land such as Saha District and Sasang Station, costing approximately \$2.1 million. Finally, the projects on the ecological forest plan to construct and manage trails in urban forests. With a budget of about \$8.6 million, this project will maintain trails and pursue afforestation to reduce fine dust (Busan Metropolitan Government, 2020).

¹⁸ This survey considers proportion of residents replying to the quality of urban green spaces and rural green spaces in their province as either ‘good’ or ‘excellent’ as being satisfied by the forest environment.

Table 12. The percentage of satisfaction with forested environments by metropolitan city, 2010-2018 (unit: %)
Source: Statistics Korea

City	2010	2012	2014	2016	2018
Daegu	26.2	35.8	31.2	38.9	37.0
Incheon	26.2	30.2	33.4	29.8	40.3
Daejeon	36.6	40.0	39.5	40.1	44.4
Ulsan	34.2	41.9	37.9	34.5	44.8
Seoul	39.1	38.7	35.6	37.5	45.8
Gwangju	29.2	37.5	37.8	39.9	47.2
Busan	33.1	37.4	39.4	39.4	49.6
Sejong	-	-	-	57.9	58.9

Daegu

Daegu has tried several new projects, including expanding roof gardens in seven public and 30 private areas. Since 2007, the municipal government has consistently promoted this project to respond to climate change, expand urban green zones and reduce the heat island effect. In 2020, it spent \$22 million on greening over 146,941 m² of land on over 822 roof gardens. The seven public target areas consist of two urban mini-ecosystem projects and five public facilities to serve as cooling shelters. Those seven places will be opened to citizens for use after modification. The 30 private target areas were based on citizen applications. The conditions for application were having a building with a roof area that could be made green covering more than 35 m² and up to 150 m². 70% of the budget was supported by the municipal government. The types of roof gardens allowed were grass, vegetable, flowering and mixed gardens (Shin, 2021).

Furthermore, Daegu will construct trails and rest areas by releasing around \$3 million on green belt spending. The target areas are Ansim Wetland Ecological Park in Dong District, the Daeheung-dong Forest in Suseong District, Waryong, Jaraksan Trail in Dalseo District and Ilwon green area in Dalseong County. This plan will be implemented from 2023 to 2024 (Hong, 2021).

Incheon

Incheon will spend \$11.5 million to afforest 45 UGS covering about 105,000 m², under the expansion of the urban green project in 2021. The project will include meditation forests for citizens to rest in and making windways to connect suburbs with urban areas for better air circulation. The target areas are Yonghyeonam Elementary School in Michuhol District and Bugae Girl's High School in Bupyeong District for meditation forests and unused land in Jung District for windways. Furthermore, the municipal

government aims to plant a forest to block out fine dust around the expressway since it is considered a source of fine dust and create a smart garden (indoor garden) nearby to a surrounding industrial complex. Those projects are expected to relieve symptoms of stress among residents and provide places for healing and rest (Incheon Metropolitan Government, 2021).

Gwangju

Gwangju announced 10 green area policies for 2021. Among the 10 policies, two projects are related to green areas responding to COVID-19. The municipal government aims to expand urban parks to increase accessibility at a 10-minute walk for most residents. They hope that such green areas will help alleviate symptoms of stress and depression caused by COVID-19 and provide a place of rest. The major areas are Hwajeong and Uncheon neighborhood parks and 5-18 Memorial Park. Gwangju has tried to become a sustainable, environmentally-friendly ecologically healthy city. A major part of that effort includes improving the accessibility of green areas through the 'Urban Forests Project'. According to the survey, the satisfaction with forested environments has increased gradually in Gwangju 2010 to 2018 (Table 12) (Kim, 2021b).

Daejeon

Daejeon announced that it would build 1,000 UGS until 2050 with a budget of \$365 million to respond to climate change and environmental issues such as fine dust and the heat island effect and be a leading city towards net-zero. The project aims to establish small but diverse types of green areas within 10 minutes from residential areas, restore green infrastructure in suburbs and maintain existing urban green forests. The accessibility gap among the regions is expected to decrease since isolated, declining and regenerated areas are targeted. Daejeon plans to implement six types of green areas: climate responsive forests that reduce pollutants, life garden forests for socializing and rest, trees along streets, ecological forests to restore resilience, carbon offsetting forests to help low-carbon economic development and citizen participation forests to expand planting culture (Kim, 2021c).

Ulsan

Ulsan ranked first on the urban green area per capita among the metropolitan cities in 2019 (Table 11). The reason for actively expanding green spaces is to overcome the city's stereotype of being an industrial city and to respond to climate change (Seo, 2020). The municipal government also shows enthusiasm for afforestation. In 2021, Ulsan designed the construction of UGS to achieve the '2050 net-zero city' and respond to climate change and fine dust. The major projects consist of forests for blocking fine dust with a focus on windways, schools and kids' safety. The forest blocking fine dust will be

implemented on 14.6 ha of land with a budget of \$9 million on Mipo and Sinil industrial complexes. The forest for windways was selected as a KFS project and implemented from 2019 to 2022, with a budget of \$17.6 million covering an extent of 20 ha. The target areas of school forests are Seongsin High School, Hyundai Technical High School and Meari Institutions with spending at \$16,000 to provide trails and rest places around those schools. Finally, the forest for kids' safety will construct a green belt in roadsides to protect the way to commuting to school, spending a total of \$61,000. The target places are Baekhap, Mipo and Maegok Elementary Schools (Kim, 2021a).

Sejong

Sejong City was established in July 2012 as the administrative capital of Korea. The population is about 300,000 residents, which has increased gradually. The urban green area per capita is quite low, but the ratio of satisfaction with the green environment is high (Table 12). In 2020, Sejong built urban windways. With a budget of \$17.5 million, the project will be implemented through planting in suburban areas, diversifying the species of trees and building forest around roads and streams by 2022. The added greenery is expected to attract wind into the urban areas from the suburbs and help to block out fine dust (Park, 2020). Furthermore in 2021, the municipal government set up a plan to build a forest for kids' safety to prevent traffic accidents around school zones. The pilot project will first be implemented in two elementary schools with a budget of \$400,000. The project will later be expanded to eight more elementary schools and conclude in 2025 (Sejong City Hall, 2021).

4. INTERNATIONAL IMPLICATIONS FROM THE UGS EXPERIENCE OF KOREA DURING THE COVID-19 PANDEMIC

The COVID-19 health crisis has led urban planners and authorities worldwide to understand the importance of investing in UGS. The increasing rates at which people are concentrated in urban areas are projected to add 2.5 billion to the global urban population by 2050 (UN, 2019). Currently, most of the world's megacities are located in Asia, and in the future, their ranks will be joined by fast-growing counterparts in South America and Africa. Given the seemingly accelerated and irreversible trend of urbanization, efforts to prevent another pandemic from exploiting high urban density have acquired unprecedented significance. This brings into sharper focus the relevance and utility of UGS and the need to plan and organize them on a long-term basis. This section identifies some of the common challenges countries face in utilizing UGS as they grapple with pandemics and climate change and draws potential lessons from policies and practices undertaken in Korea.

Access to public and semipublic UGS is an issue faced by communities around the world. Cities with more abundant green spaces allow their residents to enjoy more equitable access, whereas those challenged in this regard are less able. Because spaces are hard to come by in densely packed urban centers, improving access to UGS in a meaningful way would require using existing gray infrastructure¹⁹ and integrating them with green infrastructure. For example, many major cities lack permeable surfaces and growing space on public land, making the expansion of canopy cover a challenge for authorities (Plummer et al., 2020). Thus, utilizing and incorporating gray infrastructure as well as harnessing private land for green and blue infrastructure²⁰ in a systematic and coordinated manner is a necessary approach that cities need to consider, complemented by a more flexible understanding of green spaces.

In cities where access to UGS is more or less equitable across the board, the varying quality of UGS poses another challenge. For example, in some cases, more affluent residents enjoy larger parks with better features and amenities (McPhearson

¹⁹ Gray infrastructure here refers to engineering projects that use concrete and steel, examples of which are road and housing. (Rueter, 2012; Aleksandrova, 2016)

²⁰ Blue infrastructure refers to water elements like rivers, canals, ponds, wetlands, floodplains, water treatment facilities, etc. (Root-Berstein, n.d.)

et al., 2020), while low-income residents lack access to higher quality UGS due to disinvestment in local parks. It should also be noted that while urban greening is desirable and necessary for both developed and developing countries, the very real resource constraints and inequities faced by the Global South inevitably limit efforts at meaningfully exploring UGS. Hence alternative arrangements must be actively sought and devised, such as utilizing informal UGS, or ‘in-between,’ ‘liminal’ vegetated spaces that are not officially managed but rely on local neighborhoods and communities for maintenance and upkeep (Pedrosa et al., 2021).

Moreover, the increased use of UGS in public health crises strains their maintenance and capacity. To begin with, parks and small open spaces can quickly become crowded, leading to inadequate staffing, lack of security, and other problems, further discouraging users who have limited access. Furthermore, UGS may be broadly similar in terms of characteristics and properties but how they are used can vary based on the culture and behavioral aspects of the community. Such differences mean that users may prefer to visit UGS to look at the landscaping and trees, sit and walk, appreciate water features, socialize or participate in educational opportunities. Therefore, UGS policies need to consider residents’ attitudes, needs and preferences in the planning stage. This would make UGS more sustainable and fruitful and keep in the spirit of so-called ‘park democracy’, whereby all may enjoy access to parks.

An integrated and consistent approach that treats UGS not as fragmented patches but as key and adequately funded components of a long-term urban ecological system is critical. Such approach would ensure that operating UGS transcend merely providing an alternative for indoor activities in times of distress and fulfill the key demand of building back better initiatives worldwide.

4.1. UGS lessons from Seoul and their applicability to other countries

What Seoul, Korea learned from its UGS experience and how it may apply to other countries

Seoul and other cities in Korea are not immune to the problems outlined above. While the capital alone boasts as many as 2,868 parks (Park, 2021), many public parks are not well managed and are neglected by residents. Moreover, according to the Seoul Metropolitan Government's latest data, nearly half of all small parks in Seoul are built as children’s playgrounds. The parks are administered by lower-level local governments who usually lack the necessary resources and expertise to maintain the parks. Only public parks that are 100,000 m² or larger may allow private businesses such as convenience stores and restaurants to operate on the premises, which is one reason why small local parks are underused. In neighboring Japan, a law was amended in 2017 to allow private entities to run businesses in public parks to attract more people.

Unequal access is another challenge. High-end apartment complexes with parks and high-quality landscaping are increasingly popular, with tenants focusing on nature-friendly environments. However, such parks are essentially private ones that are often meant to be used exclusively by apartment residents, arguably increasing the gap in UGS accessibility between rich and poor.

While Seoul is one of the largest and densest metropolises globally, hosting one-fifth (or nearly 10.2 million) of the national population and only 0.6% of the total area of Korea, forested mountains are prevalent throughout the country. Seoul is surrounded by wooded hills and mountains that have well-paved hiking trails, as well as rivers and streams with popular riverfront parks and esplanades (Choi & Yoon, 2020). Despite such natural bounties, as of 2019, Seoul and the Greater Seoul Metropolitan Area had the lowest availability of UGS per capita in the country (Jang, 2019), amounting to as little as 4.38 m² per resident. This pales in comparison to Gangwon Province (19.73 m²) and Ulsan (17.87 m²) and trails behind Paris (13m²), New York (23 m²) and London (27 m²). The WHO recommends that cities provide a minimum of 9 m² of UGS per person (WHO, 2012). The city of Seoul will need to address this UGS deficit and re-green the city, but expanding existing spaces and infrastructure is a significant challenge.

Transforming and rehabilitating disused or underused infrastructure has been a tried and tested Seoul city practice preceding the COVID-19 pandemic. This urban regeneration approach looks to acquire greater momentum in the future to mitigate the challenges of particulate matter and pandemics, among others. Landmark examples include: Cheonggyecheon Stream, a drain that used to be covered by a freeway and overpass but which was converted into a creek and green strip coursing through the city's downtown (Habib, 2015); Seoul Forest, which replaced an abandoned horse racing track with lush wooded areas, an apple orchard and vegetable gardens, a wetland ecology park children's play spaces, and various art and education installations; the Seoulo 7017 Skygarden, a 0.8 km-long abandoned highway overpass that has become Seoul's highest botanical garden and flagship green network with 24,000 flowers, trees and shrubs on display (Barone, 2017); and Seonyudo Park, a former wastewater treatment park that is now an eco-park occupying an entire island with a garden of native aquatic plants and vine-draped reservoirs (Figure 24).



Figure 24. Seonyudo Park
 Source: a) Ahn and Kim; 2019, b) Yeongdeungpo-gu Office, 2019; c) Bradley, 2016; d) Seoul Metropolitan Govt., 2019



Figure 25. Wetland Eco Garden, Seoul Forest
 Source: Seoul Forest website, 2017

In some Korean cities such as Daegu, industrial transformation and demographic change have led to varying degrees of urban decline and increased vacant lots (Jin et al, 2021). Consequently, narrow roads, abandoned houses, and a lack of infrastructure such as parking lots provide an incentive for urban redevelopment. Still, the results are often hit-and-miss due to shortcomings in business feasibility or consensus-building among stakeholders, including residents. Hence, idle premises and spaces persist, and the cost of maintaining them is high for local governments. Such spaces frequently become sites of environmental degradation, vulnerable to waste and illegally deposited garbage. In response, local authorities have adopted an urban regeneration approach, looking at abandoned spaces as resources for urban renewal and greening rather than drawbacks. One example of a local government approach to managing vacant lots to enhance the quality of life for local residents is Seoul's 72 Hour Project (Lee, 2020), an annual exercise since 2012 which transforms such properties into UGS such as small farms, gardens, pocket parks with community shelters (Kim & Kim, 2021). As of 2020, as many as 73 sites have been transformed under this initiative, which was inspired by projects in cities such as Stuttgart, Germany and Milan, Italy. The project's name reflects that Seoul citizens formed several teams to work to reinvent and green a handful of vacant spaces around the city over three days, or 72 hours (Seoul Metropolitan Government, 2021c).

Regenerated street parks and linear parks are seen as an increasingly viable, safe and sustainable UGS approach catering to residents coping with restricted movement and reduced forms of relaxation. The largest linear park in Seoul is the 6.3 kilometer-long Gyeongui Line Forest Park, completed in 2016 and built along a railroad track that fell into disuse during the Korean War. The park stretches along five subway stations and is dubbed "Yeontral Park," combining the geographical names of Yeonnam-dong, a trendy neighborhood through which most of the park passes, and Central Park in New York City. Linear parks differ from conventional parks. They are not simply enclosed spaces with benches where visitors sit or walk-in circles but rather link multiple neighborhoods and enable residents to walk safely through them. In congested cities where space to build new green infrastructure is limited and accessibility a challenge, creating stretches like linear parks on underutilized or vacant transport infrastructure can improve and contribute toward community cohesion, equitable accessibility, pandemic and social distancing relief, and synergies with local commerce in the form of shops, restaurants and cafes. Another advantage of linear parks is that their long pathways enable visitors to spread out and avoid crowding, as is common in conventional square-shaped parks.



Figure 26. The Invisible Facemask, Grand Prize winner of Seoul City’s International Competition for Architectural Ideas, 2020

The design shows how social distancing measures can be introduced into a more conventional park area through the use of narrow passageways and added greenery. The competition further demonstrates Seoul’s UGS ambitions.

Source: Kim, 2020 (courtesy of Seoul City Government)

Seoul authorities also brought another idea forward in light of the relative shortage of space, the Public Open Space Initiative (Kim, 2020). To clarify, ‘open’ in this context does not mean that these services are outdoor or open air facilities but that these privately owned indoor facilities are open to the public, and differentiated from merely ‘public spaces’²¹ that typically indicate conventional outdoor facilities. Architects and housing developers anticipate a greater demand for private space and home amenities post-pandemic due to the expected increase of remote work, staycations and other social distancing practices, which may translate to fewer spaces for public consumption such as parks. Local authorities seeking to build green infrastructure would mean budget-defying costs in acquiring land and buildings. To overcome this, the initiative envisages private landlords and building owners providing public rest spaces similar to parks in exchange for various benefits such as property tax breaks from the authorities. Owners of vacant offices and multipurpose facilities such as eateries, karaoke bars, Internet cafes, indoor golf ranges, etc. that would face restrictions or a decline in foot traffic would benefit from such initiatives, and residents would be offered a greater range of UGS options and exposure to nature.

The following example illustrates the measure in practice. A commercial office space of about 100 m² is unable to attract tenants due to the COVID-19 pandemic. The

²¹ “A public space refers to an area or place that is open and accessible to all peoples, regardless of gender, race, ethnicity, age or socio-economic level. These are public gathering spaces such as plazas, squares and parks. Connecting spaces, such as sidewalks and streets, are also public spaces.” (UNESCO, 2021)

owner converts the office space into an indoor garden and makes about 16 m² of the space available to a public user at a time for the price of a cup of coffee. Users can also be provided with one-person booths to recline, read or listen to music. The capital investment involved in furnishing these quasi gardens would not be much greater than for some artificial lighting, mesh wire, and plants such as creepers and climbers.

Moreover, the elevated view offered by commercial high-rises would provide additional ambience and relief for residents in need of greenery and relaxation away from their houses and other confined spaces. Citizens can search for the nearest public open garden using global and domestic apps like Google Maps, KakaoMap or NAVER Map. These green spaces have considerable potential for diversification in that they need not be plant or vegetation-centered but can also be, for instance, stocked with basalt rocks and sand to replicate beaches and shores, as well as fountains and other water features.

Although the operators of such facilities may first charge high user fees, the authorities believe that their increasing popularity will spark greater competition that would eventually drive fees down and lead to more widespread accessibility. For example, Seoul's *Ttareungi*, or unmanned public bicycle rental service, led to a boom in the micro-mobility sector and the proliferation of electric scooter rentals, diversifying transportation means for urban residents.

Seoul's bid to transform its urban space into a more community-friendly one is encapsulated by drawing on the five letters comprising the name of the city and matching them with the most desirable aspects of a community: S for sustainable, wherein its members are satisfied with their living and working conditions and are happy to stay; E for equal, in that the community enjoys fairness and equality; O for openness, U for unique, such that the community is an attractive one that utilizes space and memory to share its history; and L for livable and lively, or a community with high living standards and vitality. These articulated ambitions drive the city's UGS undertakings, which in more practical terms may be spelled out as UGS that are adaptable and resilient to social calamities, UGS that enable and assist in social distancing, and UGS that transform un(der)used or disused urban spaces and facilities (Figure 26).

A significant number of urban areas in the world face similar challenges with UGS as the ones mentioned in this section. Therefore, the innovative policies that are being implemented in Seoul and the rest of Korea can provide adaptable lessons and ideas to governments undertaking the expansion and better management of UGS in other countries. These initiatives take access, equity, budget constraints, user preferences into consideration, and UGS's environmental benefits. Experiences of Korea provide valuable lessons as most policymakers and urban planning boards face similar concerns

and constraints. Overall, this paper has tried to introduce policies and initiatives that may inspire adapted solutions and homegrown innovations for greener and more resilient urban communities around the world.

5. CONCLUSIONS

Urban green spaces (UGS) improve health and environmental outcomes for urban residents by providing green areas for recreation and relaxation while supporting pollution control, biodiversity conservation, carbon sequestration and reducing heat retention. This paper analysed UGS as part of the response to COVID-19. It examined citizen perceptions about UGS and how those perceptions have changed during the Pandemic. To adjust to pandemics like the COVID-19, the usage of UGS can be a valuable tool for adaptation efforts.

Cities are, by definition, densely packed with facilities and infrastructure necessary to improve the quality of human life. COVID-19 demonstrated the vulnerability of city dwellers as the virus transmits through direct and indirect contact. In this urban environment, while people isolate themselves in indoor spaces to avoid infection, inversely they expose themselves to other physical and psychological diseases such as weakened immunity or corona blues. In this paper, UGS was presented as a helpful solution to this problem, and its possibilities were identified.

Based on the research and survey conducted for this paper, there are three relevant findings. First, people's interest in utilizing UGS has increased after the outbreak of COVID-19. The types of usage can be categorized in two: 1) reduction in UGS usage to keep social distancing, or 2) increase in UGS usage to maintain health or replace other controlled, indoor facilities. Second, Korea has widely and actively used UGS during COVID-19. The government opened various nature spaces to combat COVID-19 and COVID fatigue and collected ideas to use UGS sustainably for the dual purpose of serving society while conserving the environment. The number of people who visit indoor gardens or national forests has increased at the same time. Third, the research found that the Korean government plans to design future city areas with special consideration of UGS and improving people's quality of life.

Although various COVID-19 vaccines are now available and vaccination campaigns are ongoing worldwide, access to immunization remains unequal. As of 6 July 2021, more than 3.25 billion vaccine doses have been administered worldwide, equivalent to 42 doses for every 100 people. Unfortunately, there remains a striking gap between vaccination programmes in different countries, with some countries yet to report a single dose (Holder, 2021). Climate change, globalization and high-density urbanization may exacerbate the impacts of future epidemics and pandemics. This paper found that UGS has ecological, social and health values. Overall, there is a high potential to use UGS to cope with other pandemics or climate crises. These spaces contribute to climate

change mitigation by carbon sequestration while offering several co-benefits in cities. With increased globalization and urbanization, it will be vital to expand the availability and access to UGS for protecting human lives and the planet.

This paper attempted to demonstrate how Korea used UGS as a part of its overall strategy to manage the COVID-19 pandemic and elaborated on how the utility of such UGS was recognized and valued by its citizens. The experience of Korea can serve as a guide and provide ideas on developing a cost-effective and nature-friendly pandemic response strategy. However, there are some limitations; the case of Korea is context-specific. Also, the conducted survey requires methodological and statistical supplements for a more general conclusion. With further research and analysis, this paper can be used as a reference to utilize green infrastructure and spaces as a preferable means to urban planning and design to improve resilience to future pandemics and climate change impacts.

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ANNEX

Survey structure

Personal details

1. What is your gender? *

- Male Female Other

2. What is your age group? *

- 10s 20s 30s 40s
 50s 60s or above

3. What is your occupation? *

- Office/administrative work Manufacturing/technical sector
 Sales/service sector Homemaker
 Student Other:

4. Form of work or classes *

- Home-based and/or online In-person and/or offline
 Hybrid Other:

Gauging awareness of UGS

- Indoor gardens (indoor landscapes in department stores, Seoul Botanic Park, etc.)
 Rooftop gardens (Seoul Metropolitan Library, etc.)
 Green spaces in private residences or apartment complexes
 Green spaces in schools, public institutions, etc.
 Mountain hiking/trekking courses (Namsan Park, Bukhansan National Park walking trails, etc.)
 Boulevards and roadside green buffer zones
 Parks nearby commute routes Green spaces near urban streams
 Urban forests Reservoirs Amusement parks
 National Parks Other:

6. How do we benefit from UGS? *

- Purification of urban environment including countering air pollution, noise pollution, etc.
 Beautification of urban scenery
 Absorption of sun's heat and mitigation of heat island effect, climate regulation, etc.
 Emotional stability, emotion regulation, etc.
 Protection of settlements* from floods, snowstorms, earthquakes, etc.
 Educational, art/cultural aspects
 Other:

(* Settlements are defined here as developed land inclusive of human domiciles, transport facilities, and other usage that do not fall under other types of land usage)

7. How important do you think UGS were before Covid-19? *

- Very important Important Average
 Unimportant Very unimportant

8. How important do you think UGS are after Covid-19? *

- Very important Important Average

- Unimportant Very unimportant

Changes in UGS usage

9. How often did you use UGS before Covid-19? *

- Daily Almost daily 1-2 times per week
 1-2 times per month Rarely Never

10. How often do you use UGS in the wake of Covid-19? *

- Daily Almost daily 1-2 times per week
 1-2 times per month Rarely Never

11. Has there been a change in the frequency of your visits to UGS in the wake of Covid-19? *

- I did not visit them before but I have started visiting them. (Go to “If your usage of UGS has increased”)
 I visit them more than before. (Go to “If your usage of UGS has increased”)
 No change. (Go to “If your usage of UGS has decreased”)
 I visit them less than before. (Go to “If your usage of UGS has decreased”)
 I do not visit them at all. (Go to “If your usage of UGS has decreased”)

If your usage of UGS has increased

12. What was/were your reason(s) for using UGS before Covid-19? (You may choose a maximum of 3 responses) *

- Exercise Relaxation or meditation Connecting with nature
 Spending time with family or friends Moving to another location
 Walking pet animals Other:

13. What is/are your reason(s) for using UGS in the wake of Covid-19? (You may choose a maximum of 3 responses) *

- Exercise Relaxation or meditation
 Connecting with nature Spending time with family or friends
 Moving to another location Walking pet animals Other:

14. If your usage of UGS has grown more frequent in the wake of Covid-19, what is/are your reason(s)? *

- They are a replacement for gyms and other exercise facilities
 They enhance our immune system
 Increase in leisure time
 They are a replacement for cafes and other restricted public places
 They help to cope with depression, etc. and aid in psychological health and recovery
 They prevent disease transmission by virtue of their spaciousness
 Other:

If your usage of UGS has decreased

12. What was/were your reason(s) for using UGS before Covid-19? (You may choose a maximum of 3 responses) *

- Exercise Relaxation or meditation Connecting with nature
 Spending time with family or friends Moving to another location
 Walking pet animals Other:

13. What is/are your reason(s) for using UGS in the wake of Covid-19? (You may choose a maximum of 3 responses) *

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- Exercise
- Relaxation or meditation
- Connecting with nature
- Spending time with family or friends
- Moving to another location
- Walking pet animals
- Other:

14. If your usage of UGS has become less frequent in the wake of Covid-19, what is/are your reason(s)? *

- Reduced outdoor activity
- Reduced need for outdoor movement
- Fewer gatherings with family or acquaintances
- Cleanliness of facilities
- Constricted lanes/paths inside parks
- Lack of amenities in parks such as benches, etc.
- New/alternative activities
- Other:

Demands for UGS for reducing Covid-19 effects

15. Which mode of transportation do you think is appropriate for visiting UGS? *

- Bicycle
- Car
- Public transport
- On foot
- Other

16. How much time spent do you think is appropriate when visiting UGS? *

- 30 minutes or less
- 1 hour or less
- Between 1 and 2 hours
- Between 2 and 3 hours
- 3 hours or more

17. Which of the following facilities do you think are needed to encourage usage of UGS? *

- Rest/recreational facilities (outdoor seating, benches, etc.)
- Sports facilities (basketball courts, etc.)
- Nature/cultural immersion facilities (camp sites, forest experience activities, etc.)
- Nature “healing” facilities (forest-bathing, etc.)
- Nature-related education and exhibition facilities (natural ecology museums, etc.)

18. Which of the following services do you think are needed to encourage usage of UGS? (You may choose a maximum of 3 responses) *

- Health and wellbeing
- Comfortable places for relaxation
- Solving environmental issues (heatwaves, flooding, micro dust, etc.)
- Senior citizens’ welfare
- Arts and culture-related activities
- Increased biodiversity
- Interaction with diverse members of the community
- Child care and educating youngsters
- Job creation
- Food and drink (eateries, cafes, etc.)
- Other:

19. Please freely state your opinion as to how UGS may be used to mitigate the effects of Covid-19.



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