Landforms

The Korean Peninsula is bordered by water on three sides. In contrast to its smooth eastern coastline, its southern and western coastlines are extremely complex. The peninsula has relatively long coastlines for its size. According to a 2014 survey, the total coastline of the mainland is 7,753 km, while the coastlines of Korea's associated islands constitute 7,210 km. Artificial coastlines resulting from coastal development and port construction have reached 5,086 km.

One of the most significant geographic characteristics of the Korean Peninsula is its prominent NNW-SSE oriented mountain ranges: Nangrimsanmaek (Nangrim Mountain Range) and Taebaeksanmaek (Taebaek Mountain Range). These mountain ranges resulted from the formation of a back-arc basin on the edge of the Asian continent, a process that also produced the Hamgyeongsanmaek (Hamgyeong Mountain Range) and the Sikhote-Aline Mountain Range in Russia. The Ulleung Basin, located in the East Sea, was formed due to the Taebaeksanmaek uplift.

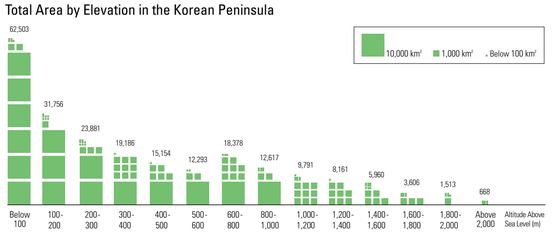
The average elevation of the Korean Peninsula is approximately 448 m above sea level, which is notably lower than that of East Asia (910 m). The mean slope of the peninsula is 5.7˚, which is two degrees steeper than the mean of East Asia (3.9˚). Overall, while the peninsula has a lower elevation than that of East Asia, it has a significant spread of steep mountainous regions. 77.4% of South Korea is covered in mountainous areas that are less than 400 m in elevation.

High mountains are asymmetrically located to the east and north of the peninsula, following the ranges of Taebaeksanmaek, Nangrimsanmaek, and Hamgyeongsanmaek. The last two ranges contain the highest elevations; Dojeongsan, Kwanmobong, Duryusan of Hamgyeongsanmaek and Heesaekbong, Maengbusan, Nangrimsan of Nangrimsanmaek are all peaks that stand over 2000 m. On the other hand, Taebaeksanmaek – which runs 500 km from Youngheung Bay in North Korea to Busan in South Korea – has a much lower elevation. Major mountains such as Geumgangsan, Seoraksan, and Odaesan are about 1,500 – 1,700 m high.

Toward the southern part of the peninsula, granite is distributed in circular or girdle-shaped areas between metamorphic rocks. Well-developed erosional basins form on the granite and are encircled by high peaks of metamorphic rocks. These erosional basins characteristically include transit zones with gentle slopes of 1 – 10˚ that are located between steep mountains and flat plains.

Because Taebaeksanmaek and Hamgyeonsanmaek are located on the eastern region of the Korean Peninsula, most large rivers flow southwest from the major watersheds of the mountain ranges. Meanwhile, streams that lead into the East Sea on the steeper eastern slopes of the ranges are shorter. This disparity is a central characteristic of rivers on the Korean Peninsula. Due to the peninsula's relatively high average slope and significant seasonal difference in precipitation, Korean rivers are also characterized by a high coefficient of river regime. Furthermore, most rivers display wide valleys and gentle gradients.

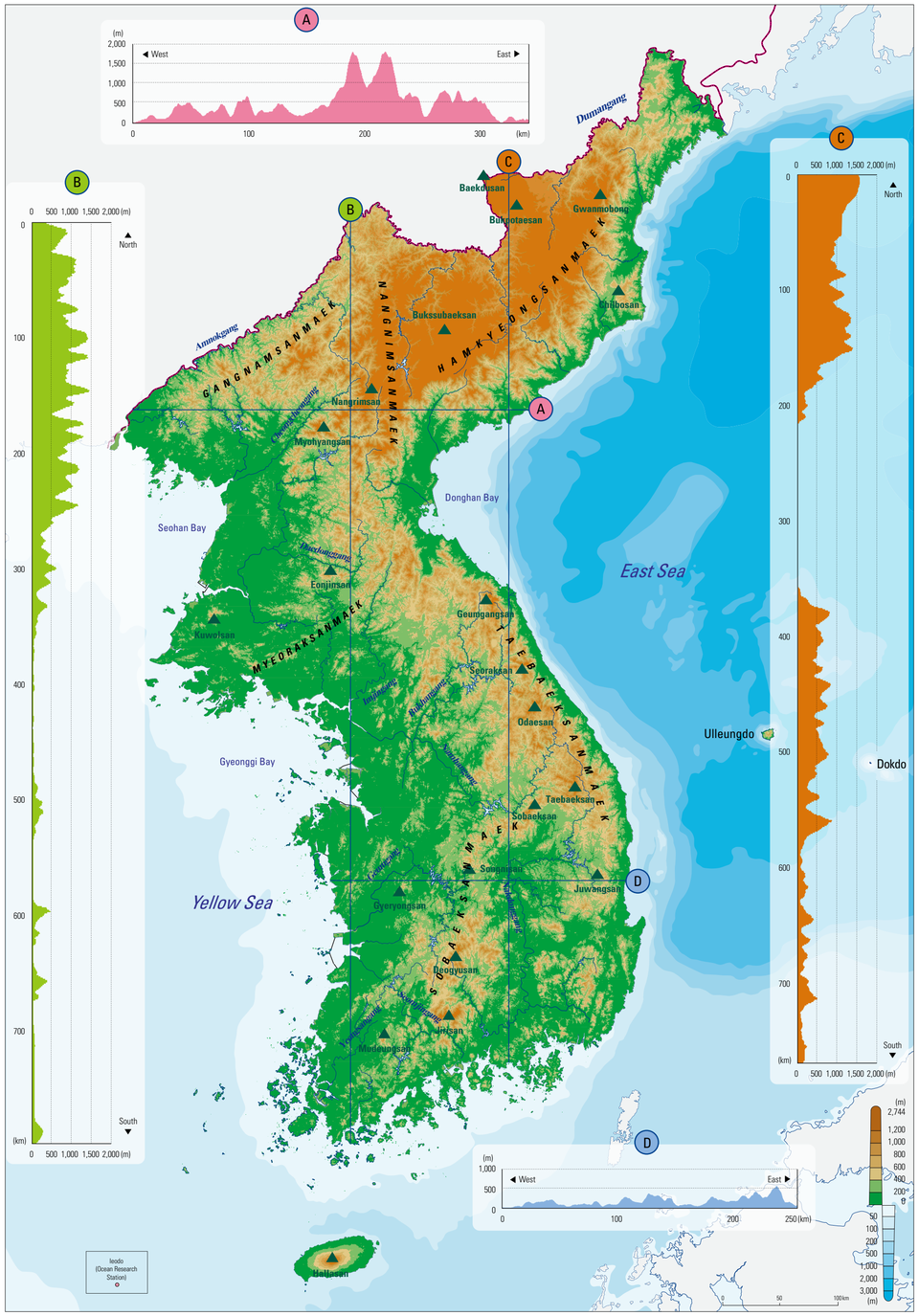
Total Area by Elevation in the Korean Peninsula



National Geographic Information Institute (2015)

Landforms of Korea

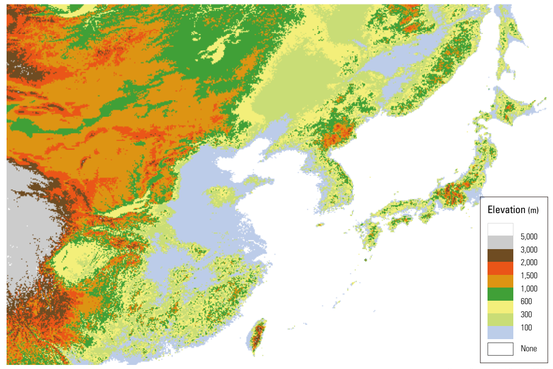
Topographic Relief and Profiles of the Korean Peninsula



National Geographic Information Institute (2015)

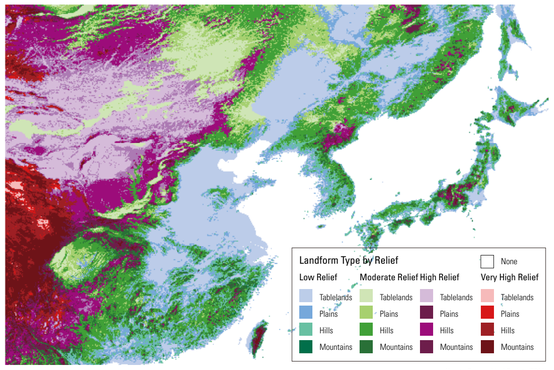
Landform Characteristics

Topographic Relief in East Asia



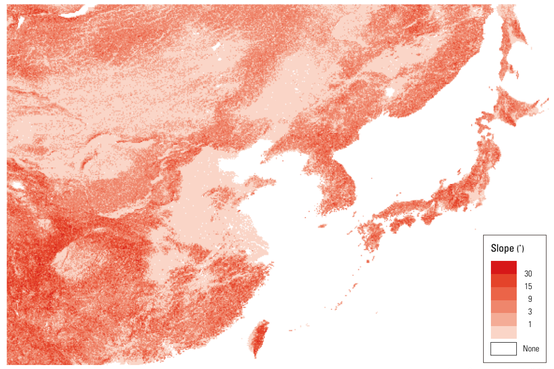
Korean Geographical Society (2014)

Classification of Landforms in East Asia



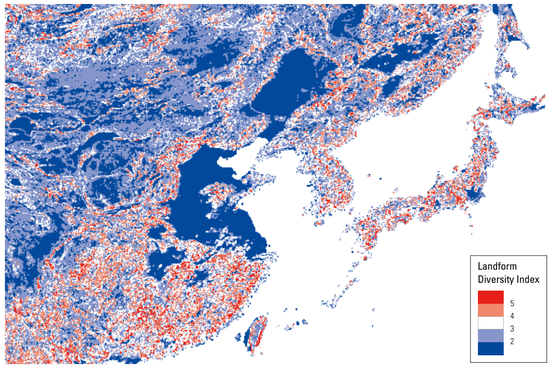
Korean Geographical Society (2014)

Topographic Slope in East Asia



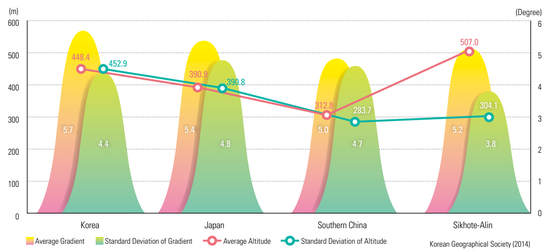
Korean Geographical Society (2014)

Diversity of Landforms in East Asia



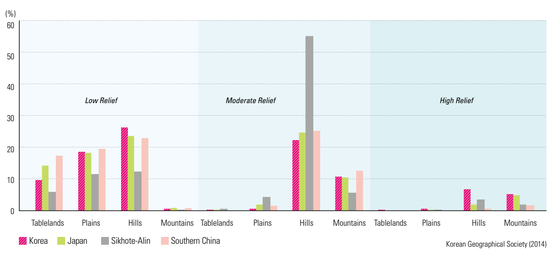
Korean Geographical Society (2014)

Average Elevation and Slope in Selected Regions in East Asia



Korean Geographical Society (2014)

Landform Diversity in Selected Regions in East Asia



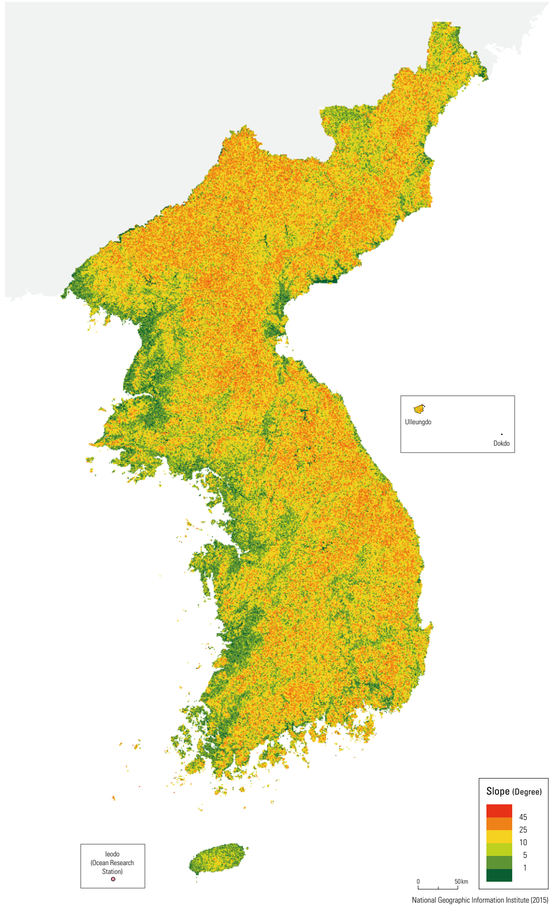
Korean Geographical Society (2014)

According to the Landform Classification, 77.5% of the Korean Peninsula is comprised of low-level mountainous areas (26.2%), medium-level mountainous areas (22.1%), low-level flatlands (18.5%), and medium-level mountain areas (10.7%). The Landform Diversity Index – the number of different landform units within a 100 km² area – for Korea displays an average of 2.78 with a standard deviation of 0.95. Compared to East Asia, which has an average of 2.27 with a standard deviation of 1.06, Korean landforms exhibit higher overall diversity, but have less variation within certain areas.

When considering the topography of the Korean Peninsula, the Sikhote-Alin mountain range, Southern China south of the Yangtze River, and Japan, the average elevation in descending order is as follows: Sikhote-Alin (507.0 m), the Korean Peninsula (448.5 m), Japan (390.9 m), and Southern China (312.8 m). However, the average slopes of each area show a different order; Korea (5.7˚) has the highest average slope, followed by Japan (5.4˚), Sikhote-Alin (5.2˚), and Southern China (5.0˚). Landform diversity has yet another order, with Southern China (3.0) showing the highest value, followed by Japan (2.9), Korea (2.8), and Sikhote-Alin (2.6). Overall, the Korean Peninsula has high average elevation and average slope, but has the least change in slope among the four areas. While Korea has more low-level mountainous areas, Japan and Southern China display a larger percentage of low-level flatlands and medium-level mountainous areas. This indicates that abrupt changes in slope are less common in Korea.

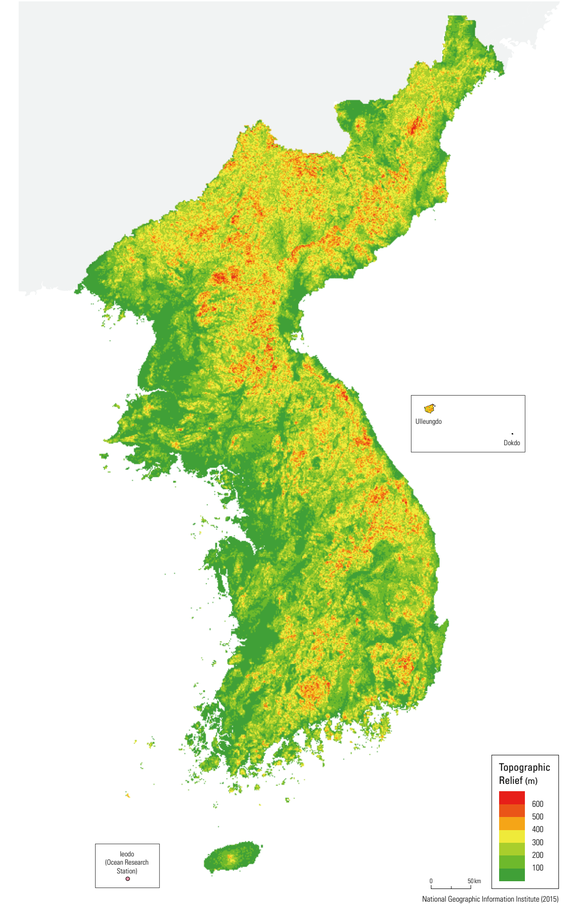
In comparison to East Asia as a whole, although the geographic features of the Korean Peninsula follow the continental geological structural lines of NE-SW, they also exhibit a perpendicular NNW-SSE orientation. It is assumed that this characteristic resulted from the formation of the East Sea, which was heavily influenced by the geological structure of the continent. The peninsula also has relatively steep mountainous areas and diverse landform features, even though it does not have high elevations. Another characteristic of Korean topography is that the boundaries between mountainous areas and sedimentary flatlands are rather unclear. This phenomenon can be explained by slow tectonic movement and relatively small sedimentary flatlands across the peninsula.

Topographic Slope



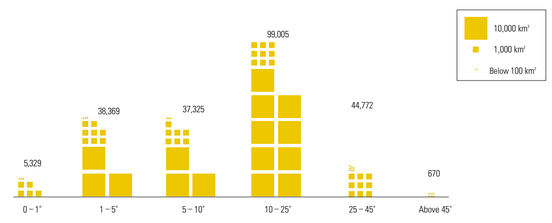
National Geographic Information Institute (2015)

Topographic Relief



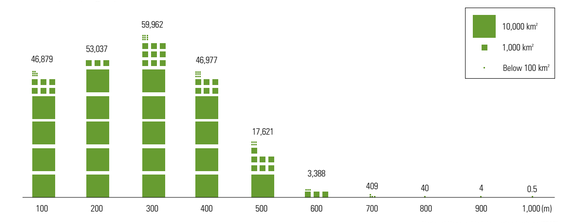
National Geographic Information Institute (2015)

Area by Slope



National Geographic Information Institute (2015)

Area by Topographic Relief



National Geographic Information Institute (2015)

The elevation of the Korean Peninsula ranges between 0 – 2,744 m, with areas lower than 100m accounting for 27.8%. 52% of the total are areas less than 300 m, while areas above 1,600 m only make up 5%. Overall, as the elevation rises, the distribution area is reduced.

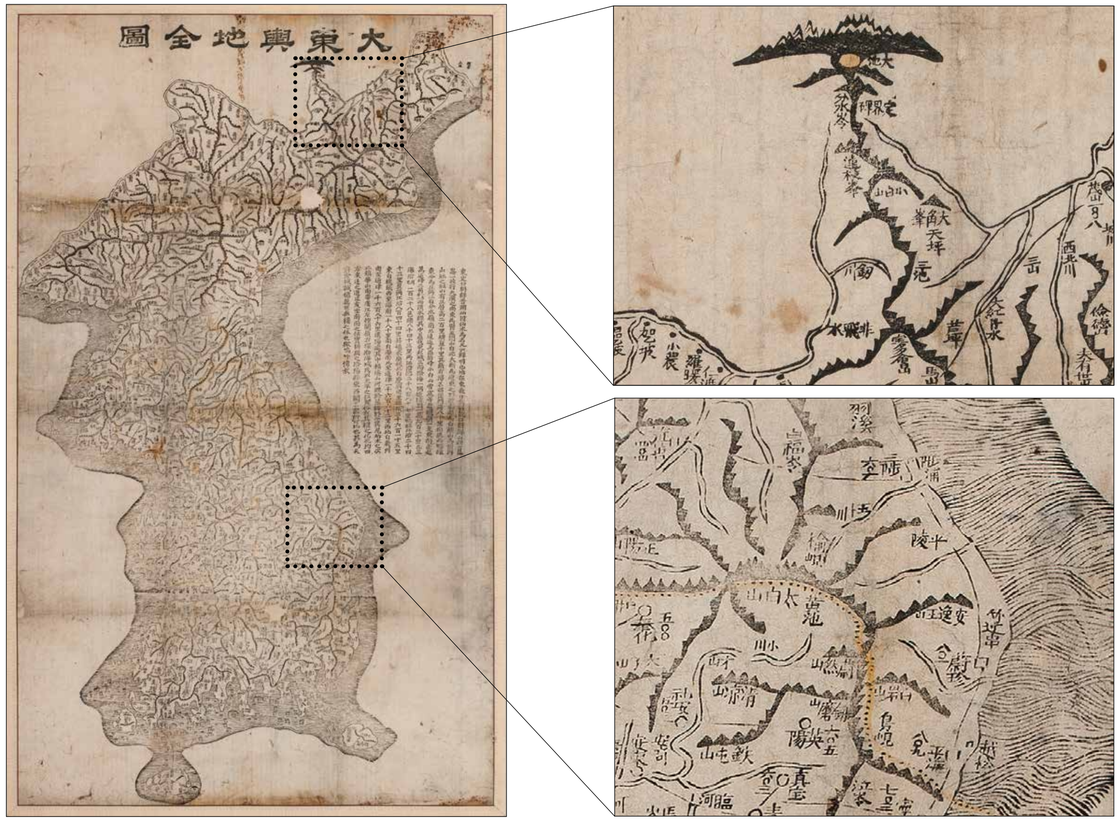
Low elevation areas under 300 m are located along the coastal and plain areas, whereas the mountainous regions of North and South Korea account for most of the 300 – 1,000 m elevation areas. Regions exceeding 1,500 m in height can be found near the Baekdusan-Gaemagowon region of North Korea, accompanied by some of the highest peaks of Taebaeksanmaek and Sobaeksanmaek.

As for area distribution according to slope, 36% of the land has lower gradients than 10˚, 44% are between 10 – 25˚, 20% are between 25 – 45˚, and 0.3% has more than 45˚ inclination. The majority of the gentle slope areas correspond to coastal regions. On average, slope is proportional to altitude – the higher the altitude, the steeper the slope. However, the widely distributed lava plateau of the Baekdusan area is an exception where the high elevation of the mountain is not equally attributed to the high gradient of the region.

The local relief – calculated by subtracting the minimum elevation from maximum elevation within a 7 km radius – of the Korean Peninsula is between 0 – 968 m, with an average of 226 m. Most of the peninsula demonstrates less than 500 m of relief, accounting for 98% of the total. Regions with relief of more than 500 m only constitute 2% and are distributed in the peaks of Hamgyeongsanmaek, Nangrimsanmaek, Taebaeksanmaek and Sobaeksanmaek. When separated by 100 m relief intervals, 26% of the area consists of 200 – 300 m relief, representing the largest proportion of the area distribution; regions between 900 – 1,000 m relief account for only 1%.

Changes in the Recognition of Landforms

Historical Map (*Daedong yeoji jeondo*, 大東輿地全圖)



Museum of Sungshin Women's University

Daedong yeoji jeondo, housed in the Sungshin Women's University Museum, is a reduction from the original *Daedong yeojido* to a smaller scale (65 cm by 110 cm) by the great Korean cartographer Kim Jeongho in 1861 (Year 12 of King Cheoljong). Mountains are represented in this map using a chain-like feature – connecting mountain ranges with a line – similar to that used in *Daedong yeojido*. Famous mountains such as Baekdusan, Jangbaeksan, Geumgangsan, Nangrimsan, and Odaesan were indicated by highlighting the peaks with a rock shape. In addition, serrated crests were expressed in different thicknesses depending on the width and height of the crest topography, with major passes also marked on the map. The original *Daedong yeojido* (360 cm by 685 cm) covers an area spanning 19 longitudinal by 22 latitudinal lines carved on 121 wood blocks. It included 213 map pages when bound into a book.

The distribution pattern of the royal tombs of Joseon shown in *Dongyeodo* demonstrates the influence of *Pungsu* (Feng Shui) and Confucianism on their locations. These tombs are generally distributed from north to south along the mountain chains. Most of the tombs are located within 100 "ri (about 40 km)" from the royal palace, and the majority (26 tombs) are distributed within 8 – 16 km. Thirty-two royal tombs of the Joseon Dynasty are concentrated in the northeast and northwest zones of the capital city (*Hanyang*), and only seven are located to the south of Hangang. The tombs face east, northeast, or northwest, and are meticulously designed according to Pungsu principles. Most tombs are located in banded gneiss and granite with thick topsoil.

Hanseongbu in *Daedong yeojido*

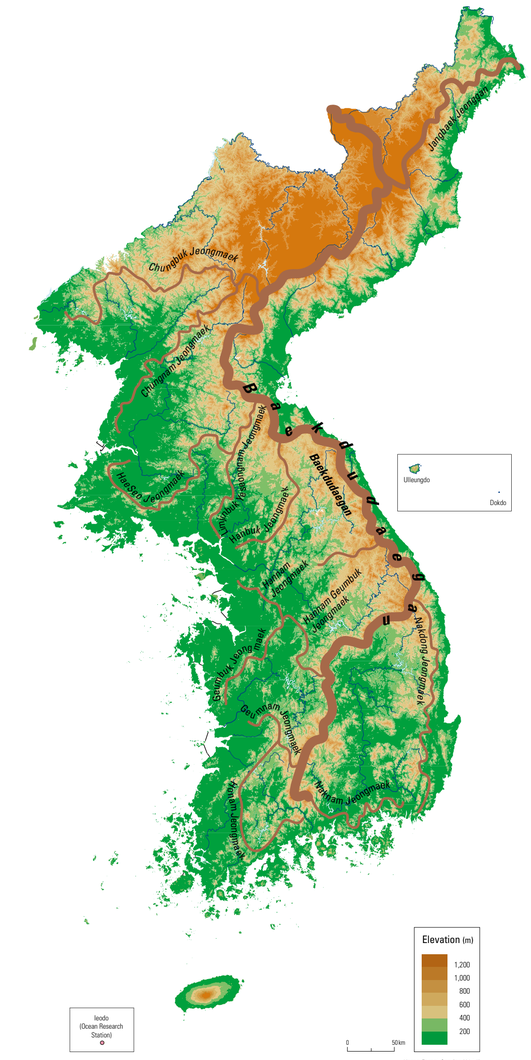
Kyujanggak Institute for Korean Studies, Seoul National University

Distribution of Royal Tombs (Part of *Dongyeodo*)

* Red circles indicate the location of the royal tombs

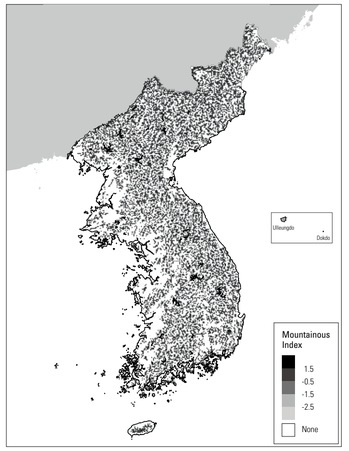
Kyujanggak Institute for Korean Studies, Seoul National University

Mountain Chains (*Daegan* and *Jeongmaek*)



Korea Forest Service (2015)

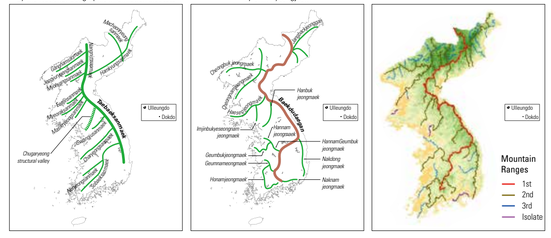
Mountainous Index



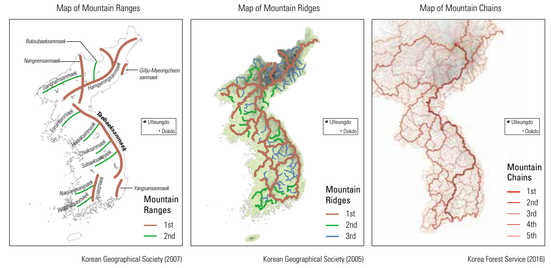
Korean Geographical Society (2005)

Various Perspectives of Mountain Ranges in the Korean Peninsula

Landform Development Processes	Distribution of Watersheds	Shape of Land Surface
Map of Mountain Ranges by the National Geographic Information Institute	Map of Mountain Ridges by Shin Kyeongjoon	"New Sanmaek Map"



National Geographic Information Institute (1982) | Lee Woohyeong (1993) | Korea Research Institute for Human Settlements (2004)



Korean Geographical Society (2007) | Korean Geographical Society (2005) | Korea Forest Service (2016)

The traditional geographical thought of Korea is portrayed in mountain ridge maps, which use lines to express the intertwined relationship of major mountains. A representative mountain ridge map is the *Baekdudaegan* map, which was published in *Sangyeongpyo* and illustrates 1 *Daegan*, 1 *Jeonggan* and 13 *Jeongmaek*.

Mountain ridge maps help us visualize the geographical unity of the Korean Peninsula by emphasizing that mountain systems are interconnected just as rivers are continuous. These maps specifically demarcate high peaks and mountain ridges, recognizing their importance as connecting passageways between living spheres and ridges. Even without modern scientific explanations of geological structures, terrain formation, and landscape changes, traditional geography emphasized watershed systems to differentiate human settlement areas. By connecting the mountain ridge of Baekdusan and Jirisan, the *Baekdudaegan* map provides a sense of unity and order throughout the peninsula and helps to secure the national symbolism of Baekdusan. The full uninterrupted illustration of the watershed further helps to identify rivers and mountain ridges more easily. In summary, Korean traditional geography is beneficial for the efficient development and usage of the mountainous terrain and understanding Korean geomorphological features through the lens of Pungsu.

Making up a large proportion of the Korean Peninsula, mountainous regions and their complex distributions are mapped in multiple ways. There are three main methods that are currently being used to represent mountain distribution: the mountain range map, the mountain ridge map, and the mountain chain map.

Mountain range maps classify mountains based on the premise that mountain ranges display characteristics of the nation's geological history and tectonic movements. On the other hand, the mountain ridge system of Baekdudaegan, proposed by Shin Kyeongjoon, resembles the watershed dividing lines of the ten main river basins in Korea and reflects the connectivity of the mountains. Understanding mountains based on river basins is a unique way of geographically visualizing indigenous nature in Korea. Lastly, mountain chain maps depict the prominence and connectivity of mountains to their neighboring mountains.

History of Topographic Mapmaking

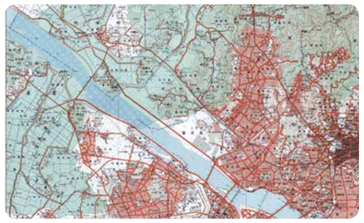
Topographic Map (1919)

National Geographic Information Institute

Topographic Map (1969)

National Geographic Information Institute

Topographic Map (1990)



National Geographic Information Institute

Topographic Map (2007)

National Geographic Information Institute

Digital Topographic Map (2015)

National Geographic Information Institute

Image taken by Arirang Satellite (2015)

Korea Aerospace Research Institute

In late Joseon, modern topographic maps were introduced into the nation and coexisted with traditional maps. Modern mapmaking can be traced to the Korean Empire Period with the publication of *Daehan jeondo* in 1899. This map was the nation's first attempt to utilize latitude and longitude as its coordinate system. Efforts to make cadastral maps and topographic maps based on land surveys in 1909 were thwarted by the Japanese occupation. From 1914, the Japanese Governor-General of Korea made 722 1:50,000 scale topographic maps of the whole Korean territory and 143 1:25,000 scale topographic maps of major urban regions for land exploitation and military purposes.

After the independence, the democratic Korean government was formally established in August 1948, and the surveying troops from the Korean Army Headquarters were in charge of mapping. In 1958, the Ministry of National Defense established the National Geographic Research Institute, the first formal mapmaking governmental organization. From 1961 to 1963, the institute converted and revised 350 military topographic maps (1:50,000 scale) covering South Korea and made them available to the public.

Experiencing fast economic growth and an increased demand for maps, the Korean government tried to develop a Cooperative Survey Program between Korea and the Netherlands to meet the request for precise topographic maps on a large scale. From 1967 to 1974, most parts of South Korea were mapped at a scale of 1:25,000 to produce 765 new maps. The National Geographic Information Institute was established under the Ministry of Construction in 1974, and have since consecutively produced 1:5,000 scale topographic maps and 1:250,000 scale thematic maps that include coastal base maps, land use maps, artificial satellite imagery maps, and aerial photo maps.

Automated map production was first introduced in the mid-1980s. Using data from the National Geographic Information System (NGIS), digital topographic maps at scales of 1:1,000, 1:5,000, and 1:25,000 were being produced by the late 1990s. From 2001, the maps are continuously being updated and revised. By 2003, the second set of digital maps (topographic maps 2.0) was completed and the fully automated production process of maps at a scale of 1:5,000 fueled its commercialization. New mapping technologies are now being developed with the Mobile Mapping System (MMS), aerial photography, and construction drawings.

Korea began its Space Development Plan at the end of the 1980s to promote cutting-edge technology. Based on the master plan for long-term national space industry development, various initiatives were launched in the 1990s, including the development of artificial satellites. The first artificial satellite, KITSAT-1, was launched on August 11, 1992, successfully drawing public attention and support for the national space industry. Satellite imagery is utilized for a wide range of applications, such as monitoring potential natural disasters and analyzing resource use. Information collected from satellite images serves as basic data for geographic information systems and ultimately contribute to balanced national development. Many fields have benefited from artificial satellites; broadcasting and communications services, marine observation, natural disaster prediction, and weather forecasting are just some of a continuously expanding range.

Korea created its third long-term plan for national space development and expects to launch twenty more satellites. It is striving to further develop space technology and forge international partnerships to take part in the space station project, and thus aims to become a front-runner in the global space industry within the next ten years.

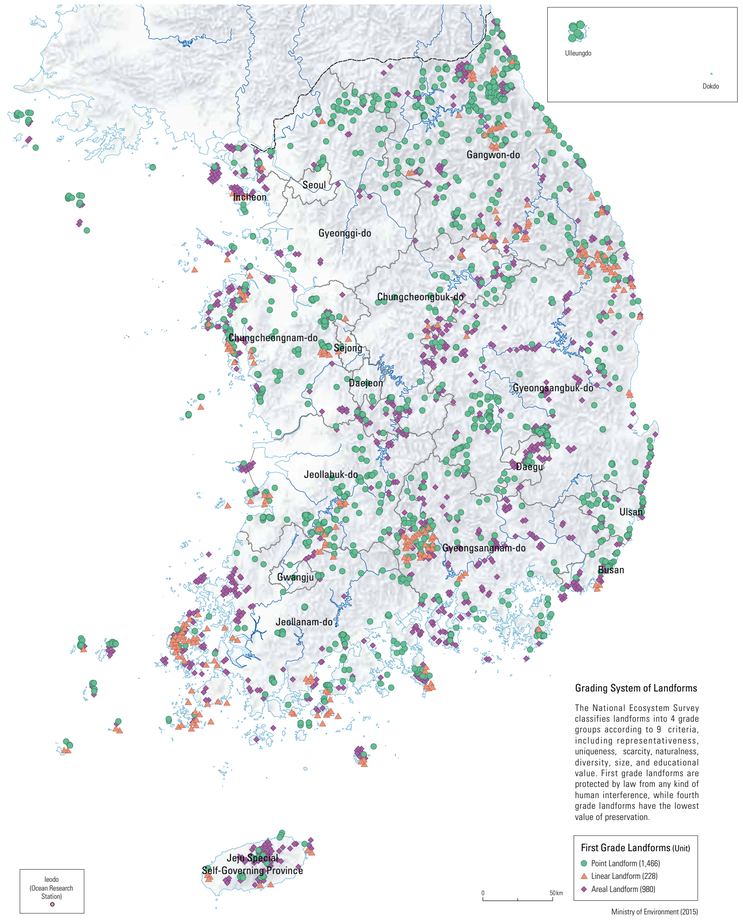
History of Korean Satellite Development

* Arirang 4 and Mugunghwa 4 were skipped on purpose

Name of Satellite	Launch Date (yyyy/mm/dd)	Properties and Missions	Owners
Wooribyeol 1	1992/08/11	First Korean satellite/Technology development, scientific development, education, capacity building	Goverment
Wooribyeol 2	1993/09/26	First Korean satellite built with domestically-produced parts/Space and earth observation, fundamental communication technology development	Goverment
Mugunghwa 1	1995/08/05	First Korean broadcasting and communication satellite/Broadcasting business for Korea Telecom	Private
Mugunghwa 2	1996/01/14	Commercial wideband broadcasting and communication satellite	Private
Wooribyeol 3	1999/05/26	First domestically designed satellite/Universe and earth observation	Goverment
Mugunghwa 3	1999/09/ 04	Commercial broadcasting and communication satellite	Private
Arirang 1	1999/12/21	First multi-purposed satellite with digital camera on board/Mapping terrestrial areas, oceanographic observation	Goverment
Scientific Technological Satellite 1 (Wooribyeol 4)	2003/09/27	First Korean low-orbit micro satellite/Universe observation and universe life searching	Goverment
Hanbyeol 1	2004/03/13	Digital media service satellite/Digital Multimedia Broadcasting (DMB)	Private
Arirang 2	2006/07/28	Low-orbit satellite with 1-meter spatial resolution/Monitoring natural disasters, mapping land use and resources, basic source for Geographic Information System	Goverment
Mugunghwa 5	2006/08/22	Commercial satellite/Private and military purposes	Private
COMS (Chollian 1)	2010/06/26	First Korean geostationary satellite/Communications, meteorological observation, ocean observation	Goverment
Alleh 1	2010/12/28	High definition TV and 3D Broadcasting	Private
Arirang 3	2012/05/18	Multi-purpose satellite equipped with a sub-meter resolution camera/Observation of environment, oceanography, meteorology, geology, forestry, water resources, etc.	Goverment
Naro Satellite (Wooribyeol 5)	2013/01/30	Satellite developed with domestic research technology/Solar storm observation, laser communication	Goverment
Ariang 5	2013/08/22	Multi-purpose satellite with sub-meter resolution camera and SAR sensor/Weather-independent observation	Goverment
Scientific Technological Satellite 3	2013/11/21	Scientific and technological satellite with IR camera and small scanning imager/Scientific research, atmosphere observation, forest fire detection	Goverment

Korea Aerospace Research Institute (2015)

First Grade Landforms by National Ecosystem Survey



Ministry of Environment (2015)

Korea conducts a national ecosystem survey that inspects the comprehensive status of the natural environment. It covers abiotic components (topography, geology, land, and soil) as well as biotic components (plants and animals). This survey enhances the understanding of topological features, the distribution of plant and animal species, the level of environmental destruction, conservational value and so on, by analyzing the characteristics of each individual element.

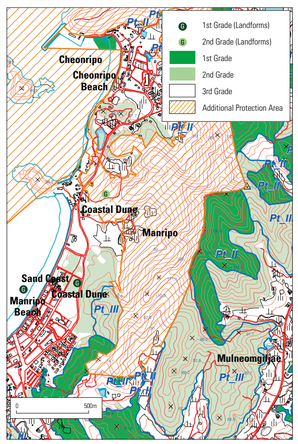
The national ecosystem survey has three components: first, a comprehensive national environment survey as a basic investigation for the natural environment; second, a targeted survey of key ecological landscapes that include inland wetlands, uninhabited islands, coastal sand dunes, estuaries, and other landscapes of outstanding ecological importance; and lastly, a species survey on legally protected, rare, and endangered wild flora and fauna.

This survey is the largest scale of its kind conducted annually in Korea, involving around 500 researchers in various fields including landforms and taxonomic groups of plant and animal species. The nation's very first survey (1986 to 1990) covered terrestrial, freshwater, and coastal ecosystems and was based on the basic plan for the national ecosystem survey (1986. Feb. 24). The landform survey was included in the second-phase survey (1997 to 2003) and has been continuously updated ever since the third survey (2006 to 2012).

Geomorphological and landscape features are some of the most fundamental components of the natural ecosystem. Topographic features directly influence surface geology, soil distribution, ground water status, and growth and reproduction of plant and animal species. The national landform survey is composed of two different surveys: one is a general survey of features such as mountains, river landforms, and coastal landforms; the other is a special survey of volcanic and karst landforms. The results of the topographic survey are categorized into points, lines, and polygons based on their attributes. The third phase survey has reported that valuable topographic features of the first grade comprise 1,446 points, 228 lines, and 980 polygons in Korea.

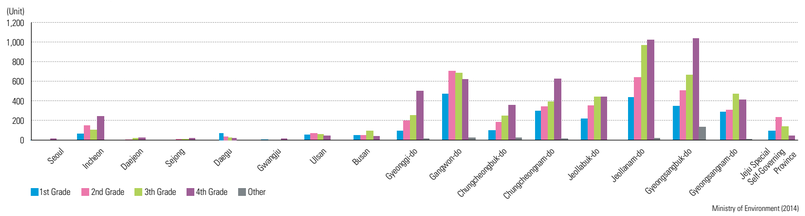
The data collected through the national ecosystem survey enhance our understanding of the landscape and is foundational to understanding the natural resource potential and the distribution of biodiversity. By incorporating this information into ecological maps, experts such as environmental managers, development planners and government officials may utilize the comprehensive overview of the survey to understand the distribution of biological diversity, establish development plans, carry out environmental impact evaluations, and conduct natural enviroment assessments.

Example of Ecosystem Survey Map (Landforms)



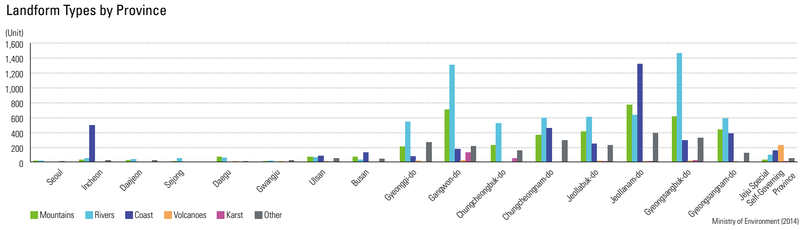
Ministry of Environment (2014)

Landform Grade by Province



Ministry of Environment (2014)

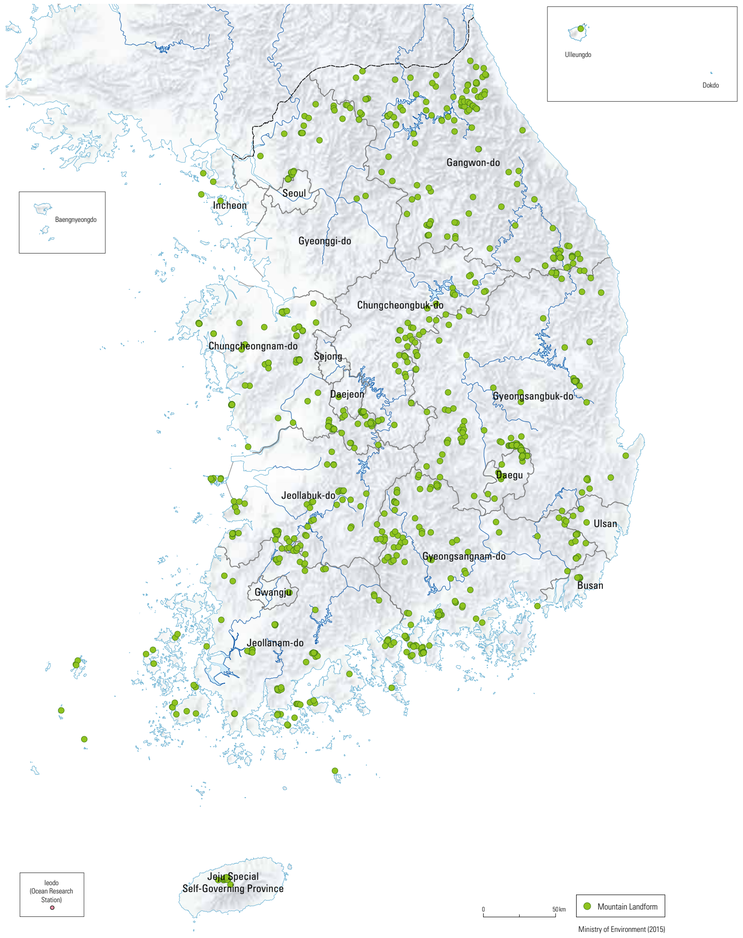
Landform Types by Province



Ministry of Environment (2014)

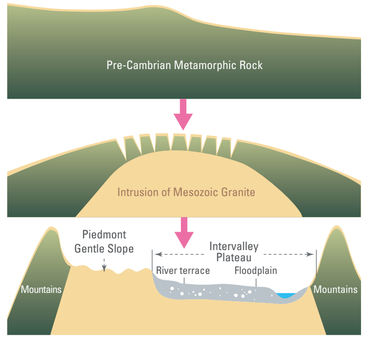
Geomorphological Landscapes

First Grade Mountain Landforms

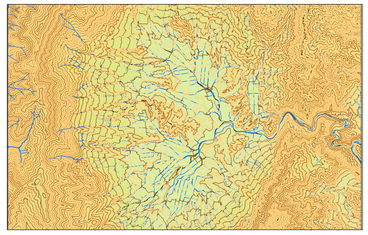


Ministry of Environment (2015)

Formation of Erosional Basins



Example of Erosional Basin (Haean Basin)



National Geographic Information Institute (2015)

Erosional Basin (Haean Basin in Yanggu, Gangwon-do)

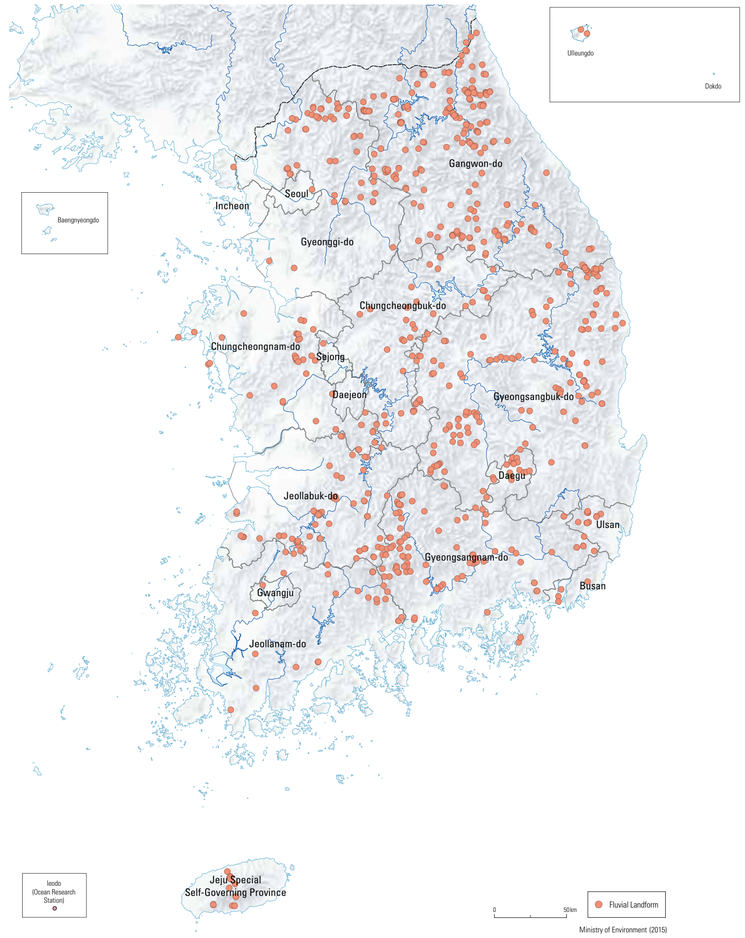
Tafoni (Maisan, Jinan, Jeollabuk-do)

Dome (Bukhansan, Seoul)

Block Field (Seoraksan, Inje, Gangwon-do)

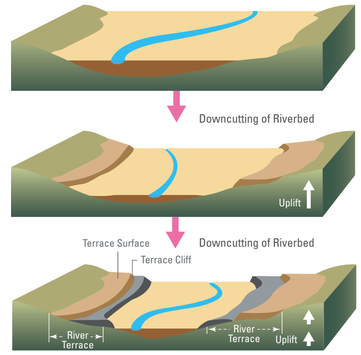
Although approximately 70% of Korea's territory consists of mountainous areas, there are not many mountains with high elevations. The highest peak in South Korea (excluding Hallasan in Jejudo) is Jirisan, which stands less than 2,000 m. The higher mountains are distributed toward the eastern side, a phenomenon that can be explained by the asymmetrical warping of the Korean Peninsula. Bedrock that is resistant to weathering and erosion constitutes the high rugged mountains, while less resistant rocks characterize the lowlands, basins, and valleys. South Korea displays a complex topographic regime due to various bedrock compositions formed over different geological periods. For example, metamorphic rocks originate from the Pre-Cambrian period, granite and volcanic rocks were formed during the Mesozoic period, and sediments remain from the Tertiary and Quaternary periods. Typical eroded and weathered landforms include erosional basins, sinuous rivers, rock cliffs, rock domes, tors, tafoni, and caves, while depositional landforms include block streams, talus deposits, and upland wetlands. According to the Natural Ecosystem Survey, first grade landforms are generally located along the high mountains of Taebaeksanmaek and Sobaeksanmaek, and are also widely distributed in island areas.

First Grade Fluvial Landforms

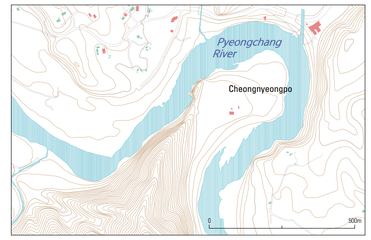


Ministry of Environment (2015)

Formation of River Terrace



Example of Fluvial Landforms (Entrenched Meander, River Terrace)



National Geographic Information Institute (2015)

Entrenched Meander (Yeongwol, Gangwon-do)

Riverine Wetland (Yeongwol, Gangwon-do)

Waterfall (Seoraksan, Inje, Gangwon-do)

Riverside Cliff (Yeongyang, Gyeongsangbuk-do)

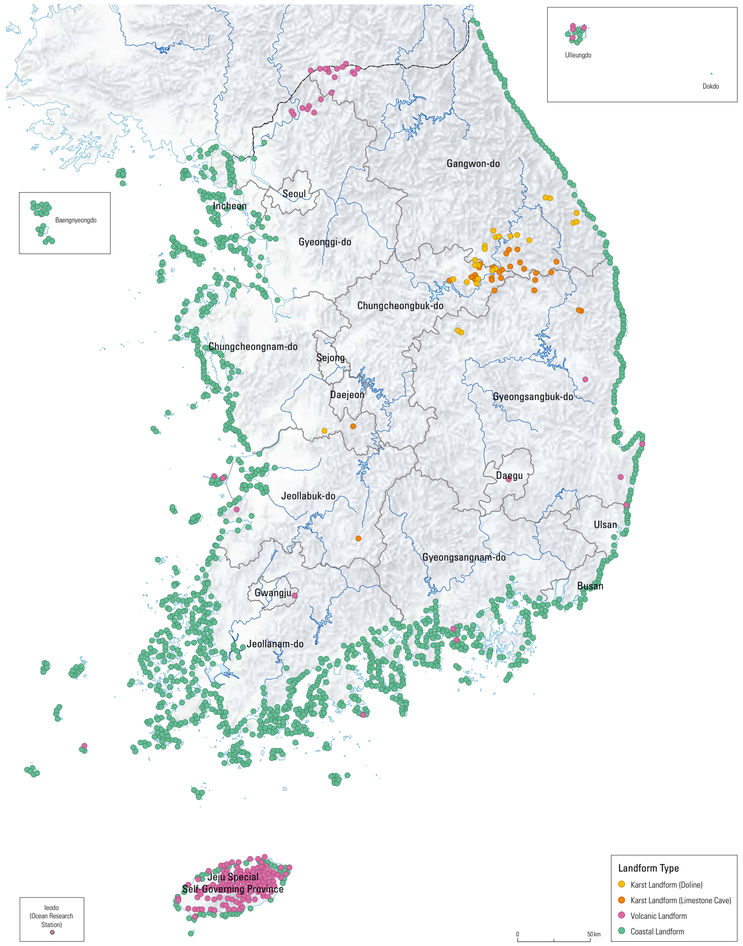
Rivers in Korea can be classified into straight, meandering, and braided. Straight rivers are bounded by exposed bedrock between narrow valleys and mounds, and meandering rivers develop on wide floodplains. Typical erosional landforms include waterfalls, potholes, riverine cliffs, and riverine caves, while typical depositional landforms are deltas, alluvial fans, riverbanks, point bars, and riverine wetlands. The floodplains formed by Hangang, Nakdonggang, and Geumgang constitute major agricultural plains in South Korea. The natural levees and backswamps of these floodplains developed from the last glacial period; eroded valleys were filled with sediments due to rising sea levels. Deltas, which are an extension of floodplains, are shaped by sediment discharge of rivers, ocean tides, and waves. They are generally located where the mouth of a river on the floodplain meets the sea. The Nakdonggang delta is a representative example. Alluvial fans are formed from small rivers and are mainly used for agriculture. Most eroded stream topography is observed in upstream areas of large rivers or around smaller rivers. In Korea, many of these regions have become tourist destinations as the exposure of bedrock creates a unique landscape. As a result, the most notable examples of river topography within the nation are generally located in upstream regions, rather than near the mouth of a river.

Tideland (Gomsoman, Gochang, Jeollabuk-do)

Sea Stack (Yokjido, Tongyeong, Gyeongsangnam-do)

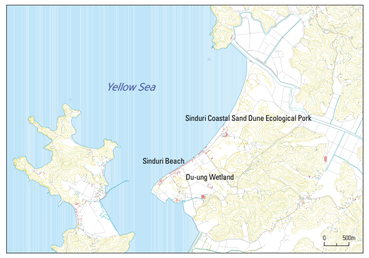
Coastal Sand Dune (Sinduri, Taean, Chungcheongnam-do)

First Grade Coastal Landforms, Volcanic Landforms, and Karsts



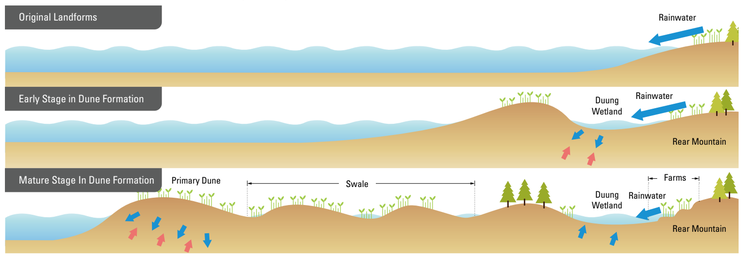
Ministry of Environment (2015)

Example of Coastal Landforms (Sinduri Coastal Sand Dune)



National Geographic Information Institute (2015)

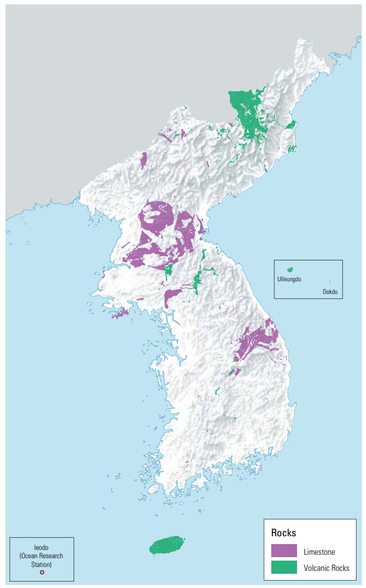
Formation of Coastal Dunes (Taean, Chungcheongnam-do)



First grade coastal landforms are evenly distributed along the coastline, mainly around relatively less-developed islands. Korean coastal landforms can be classified as rocky, sandy, or muddy. Sandy coasts are observed in bays where active sedimentation by waves occurs. Coastal depositional landforms include beaches, sand dunes, sand spits, sand bars, lagoons, and tombolo. Sandy coasts prevail in the eastern and western coastal areas, especially along regions exposed to the open sea such as the Taean Peninsula.

Rocky coasts are indicative of erosional topography and develop along the headlands of mountainous and mound regions near the sea or where wave activity is strong. They are often found near major mountain ranges along the eastern and southern coasts. Sea cliffs, wave-cut platforms, and coastal terraces are also visible along the eastern coast of Korea. Muddy coasts are found along the western and southern coasts where flood and ebb tides are farther apart, wave activity is weak, and silt-sized particles are deposited. The largest tidal flats occur in Gyeonggiman (Gyeonggi Bay), where tidal range is as large as 8 – 10 m

Limestone and Volcanic Rocks



Korea Institute of Geoscience and Mineral Resources (1995)

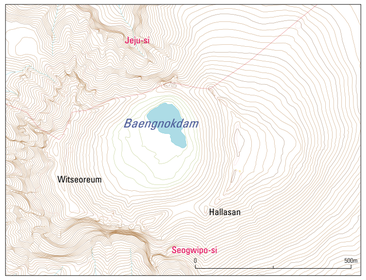
Lapies (Samcheok, Gangwon-do)

Limestone Cave (Samcheok, Gangwon-do)

Columnar Joint (Daepodong, Seogwipo, Jejudo)

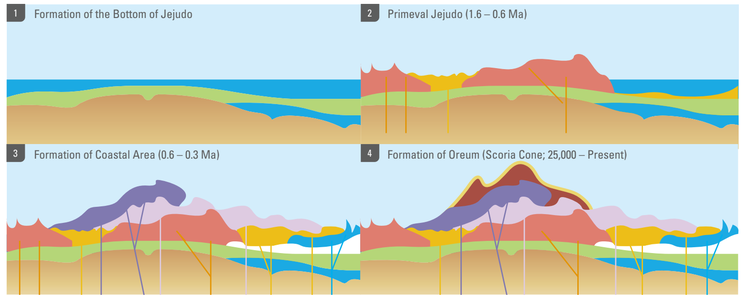
Crater Lake (Baengnokdam, Hallasan, Jejudo)

Volcanic Crater and Lake (Baengnokdam, Hallasan)



National Geographic Information Institute (2015)

Development of Volcanic Islands (Jejudo)



Although Korea does not currently have active volcanoes, vigorous volcanic activity occurred throughout the Quarternary period. As a result, distinct volcanic landforms can be observed in Jejudo, Baekdusan, Ulleungdo, Dokdo, and the Cheorwon Plateau.

Jejudo, home to Hallasan, measures 73 km from east to west and 31 km from north to south with an area of 1,847 km^2. It is an ellipsoid shape extending E-NE and has gentle slopes, which is typical for a shield volcano. Jejudo was formed by hydro-volcanic activity during the Quaternary period and displays diverse volcanic landforms that are not generally seen on the Korean Peninsula. It has recently been designated as a geopark and a UNESCO World Heritage Site. This can be seen as an acknowledgment of Jejudo's landscape value as a natural resource.

Ulleungdo and Dokdo are islands formed by the exposed peaks of a submarine stratovolcano. Unlike Jejudo, these islands have undergone extensive erosional processes resulting in hilly topography. Ulleungdo is a massive volcano that stands at over 3,000 m from the seafloor to its highest peak, Seonginbong (the depth of water is 2,200 m; Seoninbong is 983 m). During the Tertiary period, basal eruptions produced an aspite that stood over 2,000 m high on the eroded continental plate. At the end of the Pliocene epoch, overall denudation resulted in a wave-cut terrace, on top of which alkaline lava formed the volcanic body that can be seen today.

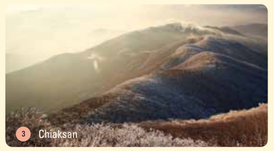
Limestone is found in two geological formations in Korea: the Pyeongnam basin and the Okcheon basin. Both basins were formed during the Cambro-Ordovician period in the Palezoic era. While the Pyeongnam basin in North Korea displays more Cambrian features, the Okcheon basin in South Korea has more Ordovician characteristics. Karst topography is concentrated around Taebaeksan, including regions such as Pyeongchang, Jeongseon, Samcheok, Jecheon, Yeongwol, Taebaek, Danyang, and Munkyeong. In particular, Yeongwol and Danyang are Korea's major limestone areas where notable features of karst – dolines (sinkholes), karrens, limestone caves – can be observed. Karrens are located in Hanbando-myeon of Yeongwol and Maepo-eup of Danyang, while dolines are commonly seen in Maepo-eup and Gagok-myeon of Danyang.

Karst topography can be categorized into three formations: concave features, convex features, and underground caves. Concave topography such as dolines and uvalas emerges when acidic rain corrodes limestone or collapses limestone caves under the surface. It is usually utilized for agriculture. On the other hand, karrens and other convex topography refer to the features that remain after the dissolution of limestone. Although large-scale karrens are not located on the Korean Peninsula, smaller karrens can be found around agricultural areas. Limestone caves develop as a result of groundwater runoff penetration below the surface, and often contain flowstones, stalagmites, stalactites, and columns that are formed through the precipitation and recrystallization of calcium carbonate. As the most well-known of the three types of karst topography, these caves often become tourist attractions. Prominent limestone caves in Korea include the Gosugul (Gosu Cave) of Danyang, the Gossigul (Gossi Cave) of Yeongwol, and the Hwanseongul (Hwanseon Cave) of Samcheok.

Natural Parks and Protected Areas


1 Seoraksan


2 Odaesan


3 Chiaksan


4 Taebaeksan


5 Bukhansan


6 Taeanhaean


7 Gyeryongsan


8 Byeonsanbando


9 Naejangsan


10 Sobaeksan


11 Woraksan


12 Songnisan


13 Juwangsan


14 Deogyusan


15 Mudeungsan


16 Wolchulsan


17 Gayasan


18 Gyeongju

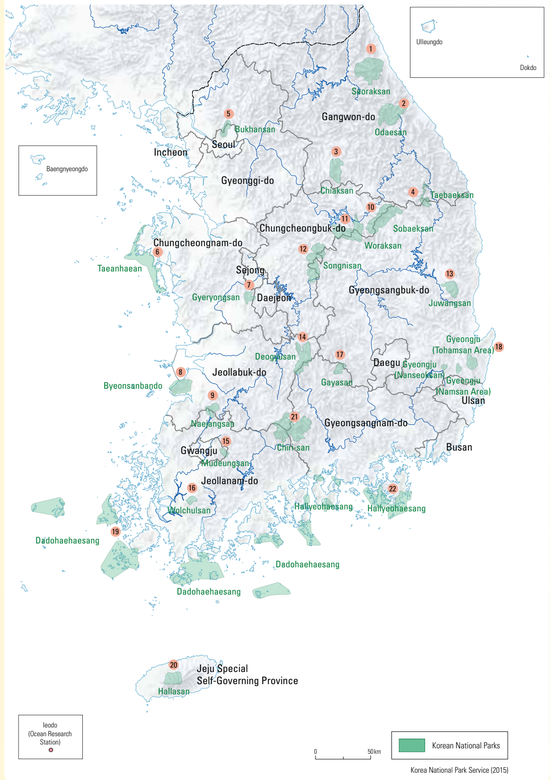

19 Dadohaehaesang


20 Hallasan


21 Chirisan


22 Hallyeohaesang

Korean National Parks



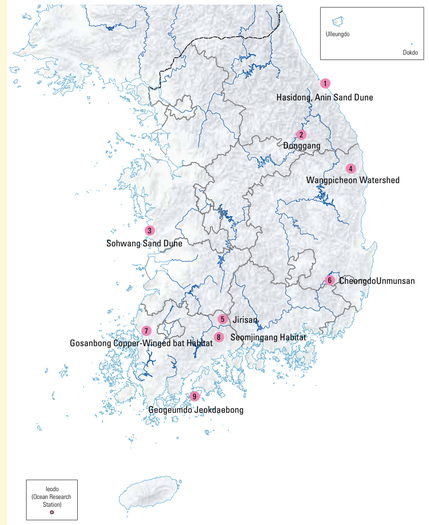
Since the designation of Jirisan National Park as the first national park in Korea on December 29, 1967, a total of twenty-two national parks have been designated and protected. Except for Hallasan National Park, which is managed directly by Jeju Special Self-Governing Province, the National Park Authority (established in 1987) manages all the national parks. The total area of the national parks is 6,653.924 km^2, of which 3,969.414 km^2 are land and 2,684.510 km^2 are sea. Among the twenty-two national parks, seventeen are associated with mountains, four are coastal, and one, Gyeongju National Park, is urban. Taebaeksan was the last to be designated as a national park on August 22, 2016.


1 Hasidong, Anin Sand Dune


3 Sohwang Sand Dune


5 Jirisan

Distribution of National Ecological Landscape Conservation Areas



Ministry of Environment (2015)


2 Donggang


4 Wangpicheon Watershed

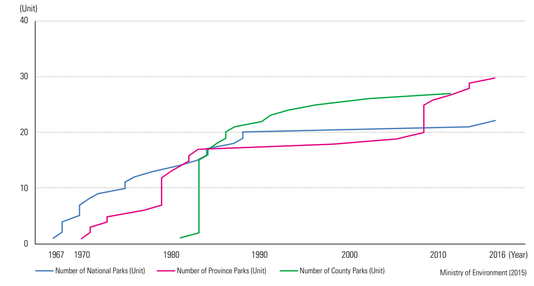

6 Cheongdo Unmunsan


7 Gosanbong Copper-Winged Bat Habitat


8 Seomjingang Habitat

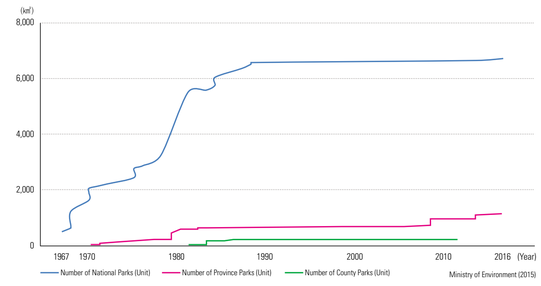

9 Geogeumdo Jeokdaebong

Number of Natural Parks by Year



Ministry of Environment (2015)

Area of Natural Parks by Year

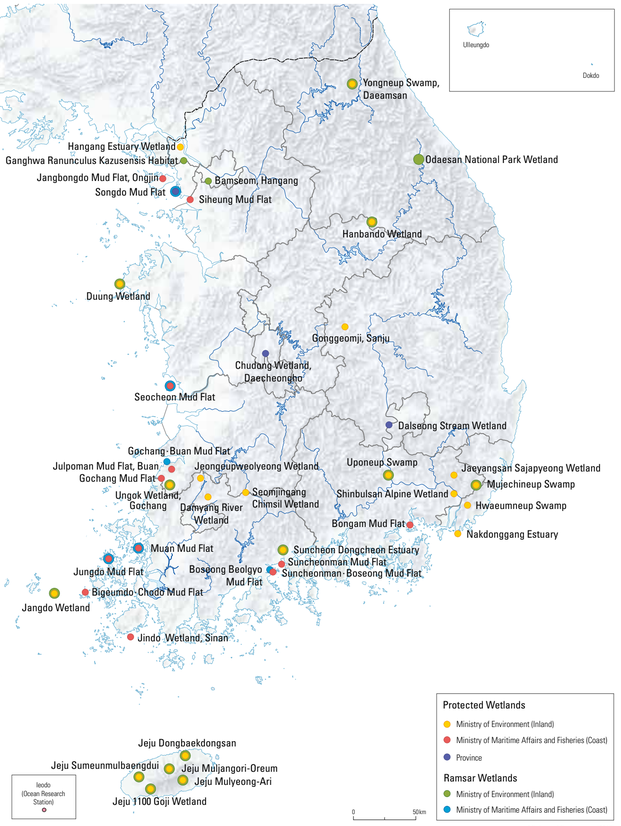


Ministry of Environment (2015)

Other than national parks, various regions have been selected and designated as natural parks in order to protect ecosystems and cultural landscapes. Among these natural parks, some prominent examples include provincial and county parks, as well as ecological landscape conservation areas. Provincial parks are representative areas of natural ecosystems and landscapes in metropolitan cities and provinces. As of 2016, there are thirty provincial parks (total area 1,139.1 km^2) that have been designated. County parks are representative of local districts (si and gun) with a total of twenty-seven (total area 237.7 km^2) currently being operated. Such natural parks increase the value of the natural ecosystems and thereby provide the local community with opportunities for regional development. Lately, provincial and county parks are increasing in area as provincial municipalities are attempting to promote regional development and tourism.

National Ecological Landscape Conservation Areas are chosen and managed based on their geological-geomorphological value, vegetational importance, ecological recognition, or necessity for conservation. These areas present significant values in conservation and scholarly research of biodiversity by maintaining the primitiveness of natural ecosystems. The regions possess distinct geological or topographical characteristics that are protected for research and scenic sustenance. They also represent diverse ecosystems and possess exceptional natural landscapes such as rivers, mountains, and valleys. Nine areas are currently designated and protected across the country.

Wetlands



Ministry of Environment (2016)

Wetlands Designated by the Ministry of Oceans and Fisheries

Name of Protected Tidal Flats	Area (㎢)	Characteristics	Designation Date (yyyy/mm/dd)	Ramsar Enlisted Date (yyyy/mm/dd)
Muan Tidal Flat	42.0	Rich biodiversity and high geological value	2001/12/28	2008/01/14
Jindo Tidal Flat	1.44	Excellent landscape with rich biodiversity/Habitat for migratory birds	2002/12/28	
Suncheon Bay Tidal Flat	28.0	Habitat for hooded crane with developed ecotourism	2003/12/31	2006/01/20
Boseong Tidal Flat	10.3	Well preserved nature with rich fish resources	2003/12/31	2006/01/20
Ongjin Jangbongdo	68.4	Habitat for rare migratory bird species with rich biodiversity	2003/12/31	
Buan Julpo Tidal Flat	4.9	Well preserved nature with rare migratory snipe species	2006/12/15	2010/02/01
Gochang Tidal Flat	10.4	Vast area with landscape and water resources	2007/12/31	2010/02/01
Seocheon Tidal Flat	15.3	Well preserved nature and habitat of oyster catcher	2008/02/01	2009/12/02
Jeungdo Tidal Flat	31.3	Excellent landscape with rich biodiversity(rich halophyte and zoobenthos)	2010/01/29	2011/07/29
Bongam Tidal Flat	0.1	Wetland in urban area, habitat for rare and endangered species	2011/12/16	
Siheung Tidal Flat	0.71	Wetland located inside bay, habitat for rare and endangered species	2012/02/17	
Bigeum-Docho Tidal Flat	12.32	Habitat for benthic organism, halophyte, migratory birds	2015/12/29	
Total	225.17			

Ministry of Oceans and Fisheries (2015)

Wetlands are a haven for biodiversity and provide an ecological buffer zone for hydrological and atmospheric processes. Korea has been using wetland monitoring in order to select certain wetlands as subjects for its conversation plans. Currently, 22 protected wetlands (total area of 126.283 km^2) have been designated by the Ministry of Environment; 12 along the seaside (225,17 km^2) have been named by the Ministry of Ocean and Fisheries, and 7 (8.254 km^2) are protected by other regions and provinces. The Convention on Wetlands of International Importance (the Ramsar Convention) took place in Ramsar, Iran in 1971 and was enacted in 1975. It was intended to protect internationally important wetlands that function as habitats for animal and plant wildlife—waterfowl in particular. As of 2015, 169 countries have joined the convention, and Korea has been a member since 1997. There are 22 registered wetlands in Korea that are recognized by the Ramsar Convention, including Gangwon-do Daeamsan Yongneup Swamp, Changnyeong Uponeup Swamp, Jangdo Wetland and Suncheonman in Jeollanam-do, Chungnam Taean Duung Wetland, Ulsan Mujechi Wetland, Muan Tidal Flat, Ganghwa Maehwamareum Habitat, Odaesan Wetland, Yeongwol Hanbando Wetland, and Mulyeongari, Muljangori-Oreum, and Sumeunmulbaengdui in Jejudo.

Among Korea's 3,167 islands, all accessible and large islands are occupied by residents, while 2,675 small, remote islands remain uninhabited. Uninhabited islands are important to national territory and economics, as they are crucial defining base points for national boundaries and exclusive economic zones. From an ecological or environmental perspective, uninhabited islands are protected from human disturbance, so their conservation status is higher than that of inhabited islands. From an academic point of view, uninhabited islands have special geologic, topographic, landscape, and ecosystem features that provide opportunities to investigate changes in climate, land surface features, and sea levels. Also, uninhabited islands are more affected by ocean currents and sea waves, thus providing easier observation of various coastal topographic features that result from erosional and depositional processes. Erosional landforms such as wave-cut platforms, sea cliffs, sea caves, sea arches, sea stacks, and notches are dominantly located where the rocky coasts of uninhabited islands meet the open sea. By contrast, islands located in inland seas often have beaches and tidal flats.

Under the Act on the Conservation and Management of Uninhabited Islands established in 1997, conservation efforts have been carried out for uninhabited islands with particular landscape value or ecological importance. As of 2014, 1,170 islands have been investigated, of which 219 are registered as special islands for conservation. These special islands are mainly located in Jeollanam-do and Gyeongsangnam-do, as rias coasts are very prominent in these regions.

Islands Statistics

Class		Total	Inhabited Islands	Uninhabited Islands
Annual Statistical Report by the Ministry of Government Administration and Home Affairs (2005)	Number of islands	3,167	492	2,675
	Area (㎢)	3,912	3,827	86
Survey of Uninhabited Islands by the Ministry of Oceans and Fisheries (2006)	Number of islands	3,358	482	2,876
	Area (㎢)	3,758	3,681	76

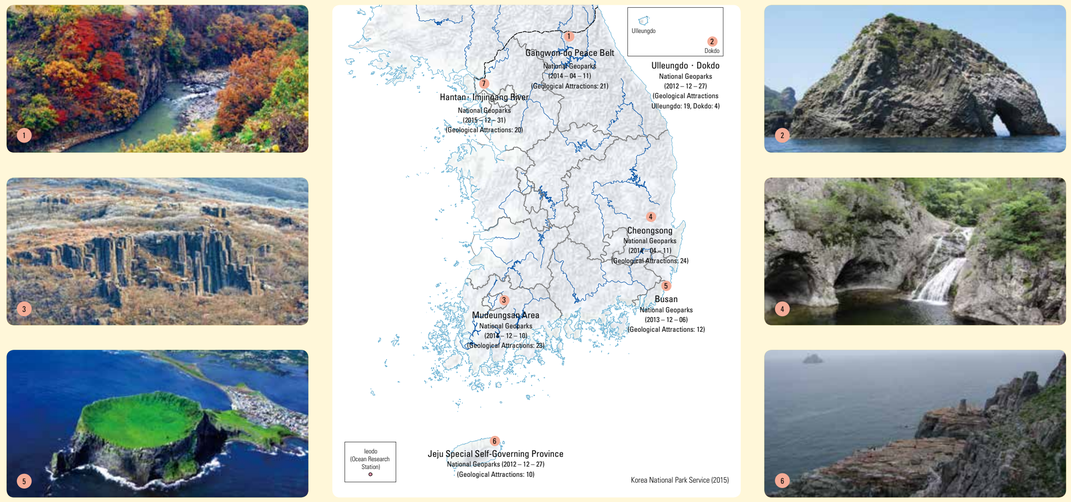
Ministry of Environment (2015)

Wetlands Designated by the Ministry of Environment

Name of Wetland	Area (㎢)	Characteristics	Designation Date (Ramsar Enlisted Date)
Nakdong Estuary	37.718	Habitat for migratory birds	1999/08/09
Yongneup of Daewangsan	1.360	The one and only highland moor	1999/08/09 (1997/03/28)
Uponeup	8.609	The oldest natural wetland	1999/08/09 (1998/03/02)
Moojechineup	0.184	Mountain wetland	1999/08/09 (2007/12/20)
Mulyeongari-Oreum	0.309	Top of scoria cone	2000/12/05 (2006/10/18)
Hwaeomneup	0.124	Mountain wetland	2002/02/01
Duung	0.067	Wetland developed behind the coastal dune/Habitat for rare plant and animal species	2002/11/01 (2007/12/20)
Sinbulsan Alpine Wetland	0.308	Habitat for rare plant and animal species	2004/02/20
Damyang River	0.981	Habitat for endangered plant and animal species	2004/07/08
Jangdo Island Alpine Wetland	0.090	The only mountain wetland in island	2004/08/31 (2005/03/30)
Hangang Estuary	60.668	Natural habitat for variety of species	2006/04/17
Jaeyaksan Sajapyeong	0.587	Excellent landscape, well developed peat	2006/12/28
Jeju 1100 Goji	0.126	Mountain wetland/Habitat for endangered plant and animal species	2009/10/01 (2009/10/12)
Jeju Muljangori-Oreum	0.610	Crater lake/Habitat for endangered plant and animal species	2009/10/10 (2008/10/13)
Jeju Dongbaekdongsan	0.590	Rich variety of species	2010/11/12 (2011/02/14)
Gochang Ungok	1.930	Rich variety of species /Habitat for endangered plant and animal species	2011/03/14 (2011/04/07)
Sangju Gonggeomji	0.264	Rich variety of species/Habitat for endangered plant and animal species	2011/06/29
Hanbando	2.772	Eight species of legally protected species	2012/01/23 (2015/05/13)
Jeongeup Weolyeong	0.375	Six species of endangered species/ Rich variety of species	2014/07/24
Jeju Sumeunmulbaengdui	1.175	Highland wetland, rich variety of species	2015/07/01 (2015/05/13)
Suncheon Dongcheon Estuary	5.399	Riverine wetland, rich biodiversity, number of endangered species	2015/12/24 (2016/01/20)
Seomjingang Chimsil Wetland	2.037	Rich variety of species/Habitat for endangered species (Otter, Korean terrapin)	2016/11/07
Total	126.283		

Ministry of Environment (2016)

National Geopark Network



National Geoparks target areas with geological and geomorphological significance to carry out conservation activities that meet the criteria prescribed in a particular country (in the case of Korea, the Ministry of Environment certification). National and World Geoparks are almost identical in their assessment and certification procedures, management structures, and operating systems. As of 2016, Korea operates seven National Geoparks: Jejudo, Ulleungdo·Dokdo, Busan, Gangwon Peace Geopark, Cheongsong-gun, Mudeungsan, and Hantangang·Imjingang. Many more candidates are waiting to be designated.

The whole of Jejudo, with its diverse volcanic landforms and geological resources, is a National and International Geopark. As the first National Geopark of Korea, Jejudo is often referred to as a "museum of volcanoes" as it boasts a variety of unique volcanic landforms. There are 368 cinder cones termed *oreum* above the surface and about 160 lava tubes and caves that are located underground. It is a rare phenomenon to see so many oreums and underground tubes on one small island.

Ulleungdo and Dokdo are volcanic islands that provide essential clues explaining the formation of the East Sea. They are very important in various research fields including geology, biology, oceanography, and history. Seoninbong (986.7 m)—the highest peak of Ulleungdo—is located at the center of the island. Ulleungdo also has the Nari basin, formed by a depressed caldera, and small peaks called Albong. Some other geosites of Ulleungdo and Dokdo include Dodong and Jeodong Beach that have well-developed sea cliffs and wave-cut platforms, Gooksu Rock with its columnar joints, Daepoonggam, Elephant Rock, Turtle Rock, Bongrae Waterfall, Songgot Peak, Seoninbong Primitive Forest, and Mongdol Beach. There are a total of 23 geosites on these two tiny islands.

Busan has a variety of diverse landscape features such as coasts, mountains, and estuaries. Consequently, it has a rich geo-heritage and a wealth of cultural assets. Nakdong estuary, Songdo Peninsula, Taejongdae, Oryukdo-Igidae, Changsan, and Geumjeongsan are some of the 12 geosites in Busan.

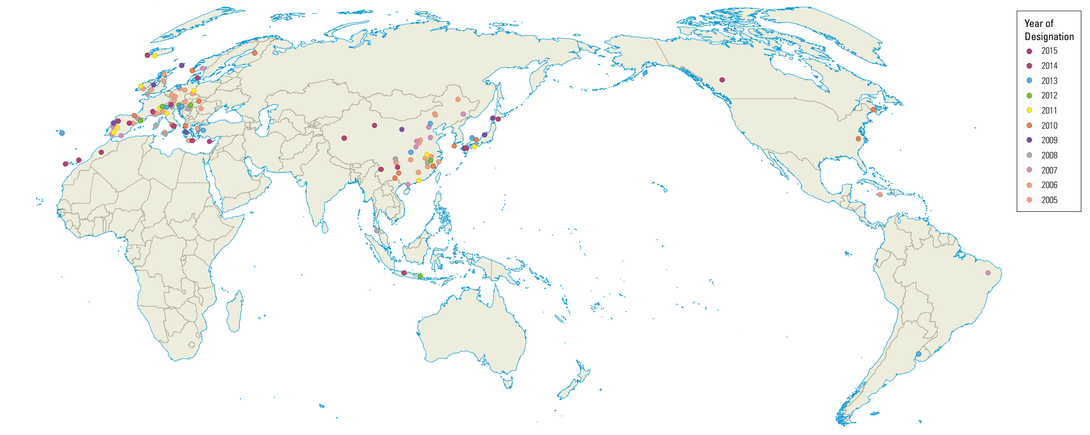
Gangwon Peace Geopark was designated in order to transform the areas around the DMZ from a symbol of Cold War hostility to a symbol of peace. It contains a rich geological and geomorphological heritage, and spans across Cheorwon-gun, Hwacheon-gun, Yanggu-gun, Inje-gun, and Goseong-gun. There are a total of 21 geosites, including the Cheorwon Lava Plateau, Haean Basin (Punch Bowl), Potholes of Naerincheon, and Hwajinpo Lagoon.

Cheongsong Geopark is famous for its magnificent landscape and plenty of historical, cultural, ecological, and archaeological heritage sites. Among 24 geosites, major locations include Yongchu Waterfall, Jeolgu Waterfall, Yongyeon Waterfall, Dalgi Waterfall, Juwang Cave, and Cheongsong Ice Valley.

Mudeungsan Area Geopark is located in Gwangju, Hwasun-gun, and Damyang-gun. It has 23 geosites such as the Seosokdae Columns and the Seoyuri Dinosaur Fossil Site, and 22 cultural heritage sites such as Mujin Goseong and Unjusa Temple.

Hantangang·Imjingang Geopark includes Jaein Waterfall and Jwasang Rock of the Mesozoic Era, Jeogbyeok Columnar Joint, Dangpo Castle, Yeoncheon Jeongok-ri Prehistoric Site, Baegeui-ri Sedimentary Layer, Dongmak-ri Tuff, Pillow Lava in Auraji of Yeoncheon, Hwajeokyoun Pond, Art Valley, and Gurai Valley in Pocheon-si. It has 20 geosites overall and has a total area of 767 km^2.

Global Distribution of Geoparks



Global Geoparks Network (2016)