Soils

Soil is an important natural medium for supporting plant growth and crop production. Recent changes in global climate and ecosystems are placing greater emphasis on the role of soil as a surface medium that controls water, atmosphere, and terrestrial ecosystems. In order to respond to increasing societal demands for balanced knowledge in this field, it is necessary to gain a better understanding of the spatial distribution, temporal changes, and inherent status of soils.

Previously, Korea’s soil classification methods emphasized the relationship between soil-forming factors and soil characteristics. Current classifications are generally made by utilizing the Soil Taxonomy established by the United States Department of Agriculture (USDA). Forest soil horizons are classified separately according to soil morphological data such as soil color, moisture condition, and parent materials.

Korea has a fairly homogeneous climate and vegetation patterns throughout its territory, but its soil distribution patterns are quite complex. This can be attributed to the country’s long history of intensive land use, diversified geological features, and rough terrain. According to Soil Taxonomy, Korea includes categories 13 orders of soil recognized on a global scale. Korea has 7 orders, 17 suborders, and 27 series groups of soils. In addition, approximately 480 soil units (the lowest level of soil classifications) have been identified to date. 64.8% (6.13 million ha) of Korean territory is covered with Histosols, which can be defined as soils that do not have clear soil horizons development. The predominance of Histosols indicates that the land surface undergoes radical change. For instance, upland soil surfaces commonly receive input from stream surfaces, and active deposition in areas such as alluvial fans, valleys, and riversides. Entisols develop soil horizons. The characteristics of Korean common soils are classified by factors of frost erosion, concentrated precipitation, high temperature, and high humidity. This accentuates the accumulation of organic matter and nutrient elements in the Korean soil horizonation. Influent forms are classified by factors of frost erosion, concentrated precipitation, high temperature, and high humidity. This accentuates the accumulation of organic matter and nutrient elements in the Korean soil horizonation. Influent forms are classified by factors of frost erosion, concentrated precipitation, high temperature, and high humidity. This accentuates the accumulation of organic matter and nutrient elements in the Korean soil horizonation. Influent forms are classified by factors of frost erosion, concentrated precipitation, high temperature, and high humidity. This accentuates the accumulation of organic matter and nutrient elements in the Korean soil horizonation. 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Korea’s mountainous topography and high population density have led the country to have the highest social demand for soil resources. In response to this, Korea carried out an extremely elaborate and sophisticated soil survey, the results of which have been made available to the public through a digitalized soil information system.

According to Jong Ch’ae (the agricultural writer and explorer) in his Nongsa jikseol (published during the King Sejong era, reigned, 1418 – 1450), the taste of the soil served as the standard for evaluating both agricultural productivity and the land price in the region. He stated that sweet-tasting soil refers to richness, while sour-tasting soil indicates barrenness, and further commented that a good soil must be constant, neither too acidic nor too alkaline, and be well-drained, having a moderate amount of silt and sand.

Modern soil surveys were first conducted in 1905, when Japanese scholars were dispatched to Korea in response to this, Korea carried out an extremely elaborate and sophisticated soil survey, the results of which have been made available to the public through a digitalized soil information system.

### Soil Survey

<table>
<thead>
<tr>
<th>Soil Survey Methods</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reconnaissance Soil Survey</td>
<td>Ecological, ecological characteristics, climate, geology, topography, etc.</td>
</tr>
<tr>
<td>Detailed Soil Survey</td>
<td>Land use, landform, land quality, etc.</td>
</tr>
<tr>
<td>Super-detailed Soil Survey</td>
<td>Groundwater, surface water, etc.</td>
</tr>
</tbody>
</table>

### Soil Survey Precise and Base Map Scale

- **1:40,000**
  - Small towns, river basins
- **1:10,000**
  - Towns, river basins
- **1:5,000**
  - Villages, river basins
- **1:2,000**
  - Communities, river basins
- **1:500**
  - Villages, river basins

### Soil Map Scale

- **Class Reconnaissance Soil Survey**
  - 1:50,000
- **Detailed Soil Survey**
  - 1:25,000
- **Super-detailed Soil Survey**
  - 1:5,000

### Soil Information System

- **Forest Soil Map**
- **Example of Reconnaissance Soil Survey Map at a Scale of 1:250,000**
- **Example of Detailed Soil Survey Map at a Scale of 1:25,000**
- **Example of Super-detailed Soil Survey Map at a Scale of 1:5,000**

### Example of Detailed Soil Survey Map at a Scale of 1:25,000

- **Soil Type**
  - Black Forest Soil
  - Gray Forest Soil
  - Red Forest Soil
  - Volcanic Ash Forest Soil
  - Lithosols
  - Acid Brown Forest Soils and Lithosols
  - Lithosols (Neutral or Basic Rocks)
  - Lithosols (Metasediments and Schist)
  - Alluvium
  - Red-Yellow Soils
  - Gray Soil
  - Sedimentary Soils
  - Eroded Soil
  - Rocky Land

### Example of Super-detailed Soil Survey Map at a Scale of 1:5,000

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### Forest Soil Map

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### Summary

Korea’s soil survey work began in 1905, focusing on studying the climate, geography, and other natural characteristics of Korea. In 1928, an irrigation association conducted a survey in order to set up a standard for field mapping. The first planned soil survey project was launched in 1930 with a three-year-long plan to study cultivated land. However, it was halted due to the outbreak of World War II.

### Advanced Scientific Soil Survey

Since the Korean War, soil surveys have been conducted to achieve systematic development and management of forest resources. A 1:25,000 scale national forest soil map was completed in 1986, and recent projects are aimed at renovating this map to be on a scale of 1:5,000 to interlink sustainable forest and ecosystem management perfectly for private farms.
Representative Soils of Korea

Soils

- Sandy Textured Paddy Soil
- Immature Paddy Soil
- Ordinary Paddy Soil

Sandy Textured Paddy Soil

- Sandy textured paddy soils are incompletely formed soils that have little horizon development because of a shorter history of cultivation. Due to their high sand content, these soils are nutrient-poor, with low levels of organic matter. The soils require adequate soil management practices, such as the use of fertilizer, to sustain high productivity of rice cropping. Sandy textured paddy soils can be found in the Gimhae plain.

Immature Paddy Soil

- Immature paddy soils can be found in new paddies and have little horizon development. These soils are nutrient-poor, with low levels of organic matter. The soils require adequate soil management practices, such as the use of fertilizer, to sustain high productivity of rice cropping. Immature paddy soils can be found in the Gimhae plain.

Ordinary Paddy Soil

- Ordinary paddy soils are distributed in highly productive paddies with no specific limiting factors. These soils meet the basic requirements for rice cropping. These soils heavily depend on the amount of fertilizer, water, and nutrients. Ordinary paddy soils can be found in the Gimhae plain. Suitable irrigation methods and fertilization are required due to their insufficient water/nutrient storage capacity. Ordinary paddy soils comprise up to 41.8% of the total area of paddy fields in Korea.

Acid Sulfate Paddy Soil

- Acid sulfate paddy soils are formed in sulfate-reducing environments where sulfate is released from the soil to the water column. These soils have a high phosphorus fixation capacity, yet their high phosphorus fixation capacity can be reduced by applying lime and phosphate used for fertilization. These soils heavily depend on the amount of fertilizer, water, and nutrients. Acid sulfate paddy soils can be found in the Gimhae plain. Suitable irrigation methods and fertilization are required due to their insufficient water/nutrient storage capacity. These soils comprise 0.3% of the total area of paddy fields in Korea.

Saline Paddy Soil

- Saline paddy soils are found in coastal areas and have low fertility. The majority of these soils are located in fluvio-marine plains that comprise 2.5% of the total area of paddy fields in Korea. Due to the intense reduction process in the subsoil, illuvial horizon located 50 cm beneath the surface, and high acidity, soil yield is very low. Drainage installations to increase nutrient absorption by crops. Saline paddy soils are common in coastal areas and have low fertility. The majority of these soils are located in fluvio-marine plains that comprise 2.5% of the total area of paddy fields in Korea. As poorly-drained paddy soils are located in paddies that are only about 50 cm above ground water level, they are at high risk of damage from soil and water loss. Due to their low fertility and high salinity, the productivity of this type of soil is naturally low. Drainage installations to increase nutrient absorption by crops. Saline paddy soils are common in coastal areas and have low fertility. The majority of these soils are located in fluvio-marine plains that comprise 2.5% of the total area of paddy fields in Korea.

Acid Clayey Paddy Soil

- Acid clayey paddy soils have a high pH value and high acidity, soil yield is very low. Drainage installations to increase nutrient absorption by crops. Acid clayey paddy soils can be found in the Gimhae plain. As poorly-drained paddy soils are located in paddies that are only about 50 cm above ground water level, they are at high risk of damage from soil and water loss. Due to their low fertility and high salinity, the productivity of this type of soil is naturally low. Drainage installations to increase nutrient absorption by crops. Acid clayey paddy soils can be found in the Gimhae plain. As poorly-drained paddy soils are located in paddies that are only about 50 cm above ground water level, they are at high risk of damage from soil and water loss. Due to their low fertility and high salinity, the productivity of this type of soil is naturally low. Drainage installations to increase nutrient absorption by crops. Acid clayey paddy soils can be found in the Gimhae plain.
Soil Association

Soils Developed from Granite

Soils Developed in Fluvio-Marine Sediments

Soil-forming factors that determine the morphological, physical, and chemical characteristics of soils consecutively appear on the land’s surface in a predictable pattern. For example, a variation in temperature or an increase in precipitation by elevation results in changes in vegetation, which are in turn reflected in the characteristics of the soil. A group of soils associated with one area that occur in a predictable pattern is called a Soil Association.

Typical Korean topography shows flatlands on both sides of a river that are adjacent to the mountains, or foothills, of nearby gentle sloping mountains. These foothills are in turn connected to the rear, meso-geographical mountains. The flow of water from mountain to river creates soil particles, leaching soil nutrients, and then deposits them on the lower part of the mountains. Rainfall infiltrating and percolating into the soil increases its water content. Floodplains experience flooding during periods of high-discharge and display high-sediment levels. As such, these soil-forming factors repeat in a continuous manner, which leads nearby soil series to develop accordingly. This process is often called Soil Continuum.
Climate—especially precipitation and temperature—are the biggest influences on the formation of soil. The Korean Peninsula has a temperate monsoon climate with four distinct seasons of spring, summer, autumn, and winter. Heavy rainfall occurs during July and August, which causes steep, high gradient slopes to have rich, shallow soils due to soil erosion. Soils originating from granite, granite gneiss, and metamorphic materials are developed from different parent materials. Soils originating from granite, granite gneiss, and metamorphic materials have low levels of cations (calcium, magnesium, and potassium), and so forth. Soils that are produced in acid rocks have low levels of calcium, magnesium, potassium, and so forth. Soils originating from volcanic ash are very dark brown or black due to their high organic material content.

The Climate of Korea has many diverse soil types, 405 series of soil horizons. A characteristic of the climate is the high temperatures and high relative humidity during the summer, autumn, and winter. The mean annual soil temperature in Korea is 5°C with January being the coldest. Mean annual soil temperature in Korea ranges from 0.9°C in March to 2.2°C in September. The differences are more significant during summer and autumn than in the spring.

As the climate of Korea shows little difference between regions, topographical factors play critical roles in soil formation processes. Consequently, the soil survey system classifies different landforms into four soil geomorphological units, according to slope gradient and cause of formation. Among the four units, metamorphic areas contain the highest proportion with 43.2% of total land area. These areas are generally used for forests and so they have shallow soils with muskeg forming (tundra). Hillsides in approximately 10% of land area, and are mostly located in eastern areas, contain one or two granitic basement. Although hills have better-developed soils than flatter areas, they are also used for forests due to the high slopes generated. Valley (10%) refers to the low area between mountainous areas that have steep slopes, commonly filled with riverine sediments and thus forming a duplex soil layer. As they usually have connected access to water sources, valleys are often utilized for small-scale paddies. Flattened (18%) can be defined as the gentle slopes that connect mountainous and plains. They are most suitable for farmlands rather than paddies as they lack a water source. Mountainous plains (9.1%) and fluvio-marine plains (3.5%) are each formed by river deposits and joint action of the sun and water. They are adjacent for agricultural usage as they have deep soil layers with high productivity. Other landform types are low hills, low plateaus, similar uplands—each contain less than 3% of total land area.
Soil texture is determined by the relative proportions of three kinds of soil mineral particles: sand (0.05–2 mm), silt (0.002–0.05 mm), and clay (particles smaller than 0.002 mm). Soil texture is often considered as one of the most important attributes that control the physical and chemical characteristics of soil.

On average, the soil in the peninsula areas of Korea is comprised of 44.3% sand, 44.5% silt, and 11.3% clay. Major soil textures are moderate coarse sandy loam (44.3%) and fine textured eluviated loam (14.3%), and soils with cover up to 7% of the total land area. Gravelly soils are also observed in 5.5% of the total area. Because Korean soils have high porosity and show good water drainage, the possible leaching of nutrients and organic matter may result in less productivity.

The lowest percentages of sand in soil, followed by fens and forest soils. Silt and clay content decreases in the same order. While poorly soils have particularly higher silt content, fens and forest soils are smaller. Soils with higher sand content are distributed throughout the mountainous regions from southern Gyeongsang to Cheongsanmarae-do and Cheongsanmarae-do. On the other hand, the amount of silt in soil is high in coastal regions, the limestone areas of the Okcheon System from southern Gangreung do to Haeundae-do and Ieoddo-do, and the spallate rock areas of the Gyeyang System in Gyeyangmarae-do and Gyeyangmarae-do.

Available soil depth represents the depth of soil horizons. Areas with deep soil are often found in areas with well-watered bedrock or areas where sediments are deposited, while areas with shallow soil represent poor soil formation or soil removed by erosion. Soil scientists classify soil available soil depth into very shallow (< 20 cm), shallow (20 – 50 cm), moderately deep (50 – 100 cm) and deep (> 100 cm). It is recommended that available soil depth should be at least 50 cm to be used as rice paddies or farmlands. In the case of South Korea, moderately deep soil depth (50 – 100 cm) constitutes the largest area at 62.5%. Moderates (20 – 50 cm) account up 23.5%, very shallow (< 20 cm) constitutes 10.0%, and deep (> 100 cm) constitutes 4.0%. Soil drainage grades indicate the type of drainage found within a soil profile and are determined by factors such as amount of rock, permeability, and groundwater level. Drainage classes are defined as follows: excessively drained (EX), well drained (W), moderately well drained (MW), moderately poorly drained (MP), poorly drained (P), and very poorly drained (VP). Most farm field soils are classified as W, while soils in two-year farming paddy fields, semi ill-drained paddy fields, and poorly drained paddy fields are classified as MP, P, and VP, respectively. Lithosols of steep slopes and sandy-silty soils of upland areas are known as EX.

Available soil depth: 60.3% (0 – 50 cm), 21.5% (50 – 100 cm), and 18.0% (> 100 cm). It is recommended that available soil depth should be at least 50 cm to be used as rice paddies or farmlands. In the case of South Korea, moderately deep soil depth (50 – 100 cm) constitutes the largest area at 62.5%. Moderates (20 – 50 cm) account up 23.5%, very shallow (< 20 cm) constitutes 10.0%, and deep (> 100 cm) constitutes 4.0%.

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The depth of forest soil is affected by various soil-forming factors including climate, topography, vegetation, parent material, and anthropogenic disturbance. In the case of forest soil in Korea, topographic and anthropogenic factors account for most forest soil depth characteristics. Along with the fact that 31% of Korea has mountains across steepness than 30°, the exploitation of forest resources during the Japanese Colonial Period and the Korean War caused severe topsoil loss. Throughout the 1970s and 1980s, a series of nationwide afforestation projects stabilized most of the devastated forest areas. However, soil development processes have yet to achieve full maturity.

The average soil depth of Korean forests is 51 cm, which is considered to be quite shallow. Furthermore, 76% of forest soils have a depth of less than 60 cm, indicating that productivity is low. Recently, forest soil management has become more important as social demands for sustainable forest resources (timber, non-timber, etc.) continue to grow.
Korea is known for its success in contributing land degradation. Long years of slash and burn farming and forced logging left many parts of its territory devastated at the end of the Korean Dynasty. To mitigate this situation, a forestation project was planned and completed for deteriorated forests around Ganghwa Island (1957), which is now considered the first nationwide reforestation project in Korea. Some major areas of land erosion control projects conducted during the Japanese colonial period include reforestation from watershed conservation, poverty relief, and soil fall forestation. These projects were generally carried out in response to frequent natural disasters as well as relief for the poor. However, during the last six years of the Japanese Colonial Period and the Korean War, forest exploitation and deforestation for war-related activities occurred throughout the country. Devastation reached its peak in 1956, with around 0.68 million ha, or 10% of South Korea’s territory devastated at the end of the Joseon Dynasty. To mitigate this situation, a forestation program was completed around 1983.

Overcoming Forest Soil Degradation

The majority of soil erosion in Korea can be identified as surface runoff erosion, while wind erosion occurs locally in coastal areas, islands, and high-mountainous areas. Soil erosion is produced by surface runoff generated by rainfall, and it can depend on the following factors: rainfall or wind intensity (R), soil erodibility (K), slope length and steepness (LS), crop management (C), and soil supporting practice (P).

Risk Factors for Soil Erosion

The risk of erosion due to wind rainfall is high in certain places like the mountainous areas of Gangwondo and the North East coastal areas like Gyeongsangnam-do, since factor R is high in the mountainous areas and factor K is high in the mountainous areas. Unlike other variables R, K is high in the northern plains other than mountainous areas in the context part of the country. Because light soil particles are carried by rainwater flow.

Soil Erosion

Soil Erosion

Factors

Wind
Rainfall
Runoff
Rural Development Administration (2015)
C = Rainfall erosivity index (ERI)
K = Soil erodibility (K)
LS = Slope Length and Steepness
C = Crop Management
P = Soil Supporting Practice

Risk of Soil Erosion (Form Soil)

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In contrast to South Korea’s great success in forestation and restoration of its forest, the afforestation of North Korea has not been as successful. Rainfall erosivity index (ERI) is high as surface erosion occurs locally in coastal areas, islands, and high-mountainous areas. Soil erosion is produced by surface runoff generated by rainfall, and it can depend on the following factors: rainfall or wind intensity (R), soil erodibility (K), slope length and steepness (LS), crop management (C), and soil supporting practice (P).

Risk of Soil Erosion (North Korea)

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Risk of Soil Erosion (North Korea)

Risk of Soil Erosion (North Korea)
As of 2013, the total land area of South Korea is 18,072,000 ha. Arable areas are estimated to be 3,732,000 ha, constituting 20.7% of the total land area. These areas consist of paddy fields and farm fields, which each comprise an area of 964,000 ha and 748,000 ha, respectively. The total area of paddies in 2014 is 0.93 million ha, making up 55% of all cultivated land. While paddy fields have been on a constant decrease since 1970, the area of farm fields only experienced a slight decrease over the same time period, remaining at 0.7 million ha since the 1980s. Starting in 2008, farm fields actually began to expand as economic growth encouraged farmers to grow more fruit trees and other cash crops. Due to the drop in rural agricultural population, cultivated land per household is steadily decreasing, experiencing a growth decline from 1970 to 2009 to 0.75 million in 2009.

Arable land area in Korea increased until the mid-1970s due to active land reclamation in coastal regions. However, industrialization and urbanization has prompted a constant decline in arable lands ever since. In 1975, Korea had a total of 2.24 million ha of cultivated land, but by 2014, that area was reduced to 1.79 million, reflecting a 26% decrease over a span of 40 years. The total area of paddies in 2014 is 0.93 million ha, making up 55% of all cultivated land. While paddy fields have been on a constant decrease since 1970, the area of farm fields only experienced a slight decrease over the same time period, remaining at 0.7 million ha since the 1980s. Starting in 2008, farm fields actually began to expand as economic growth encouraged farmers to grow more fruit trees and other cash crops. Due to the drop in rural agricultural population, cultivated land per household is steadily decreasing, experiencing a growth decline from 1970 to 2009 to 0.75 million in 2009.

Since the 1970s, Korea has been experiencing rapid change in its economic structure. It shifted from an agricultural society to a post-industrial society, consequently bringing about a diminished interest in health have introduced a newfound interest in health and safety and the photosynthetic rate of plants. Determined by soil bulk density, which considers particle size and organic content as main variables, AWRC is the soil’s ability to retain water in response to hydrologic processes such as rainfall and leaching. The total area of paddies in 2014 is 0.93 million ha, making up 55% of all cultivated land. While paddy fields have been on a constant decrease since 1970, the area of farm fields only experienced a slight decrease over the same time period, remaining at 0.7 million ha since the 1980s. Starting in 2008, farm fields actually began to expand as economic growth encouraged farmers to grow more fruit trees and other cash crops. Due to the drop in rural agricultural population, cultivated land per household is steadily decreasing, experiencing a growth decline from 1970 to 2009 to 0.75 million in 2009.

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Overcoming the global retreat against desertification, partnership is key to progress. Through the establishment of a scientific advisory mechanism, the Committee on Science and Technology (CST) enhances the implementation of the convention. Such support from the international financial institutions, the private sector, and South-South and North-South initiatives on improved support from the international financial institutions, the private sector, and South-South and North-South initiatives is critical.

Greening Drylands Partnership

As part of the Changwon Initiative, the Growing Drylands Partnership promotes a series of renewable land management projects to create environmentally friendly, productive, and sustainable development. To be carried out from 2010 to 2020 in order to establish strategic measures to accomplish the goals set by the 2006 UNCCD COP 10, the Changwon Initiative was adopted during the high-level summit. The initiative appealed greatly to participants in 2006 with its main points: 1. Agreement on long-term perspectives of the UNCCD and establishment of a scientific framework; 2. Building partnerships to eradicate desertification and land degradation effectively; 3. Increased coordination of conservation that includes the private sector; 4. Establishment of the Land for Life Award to encourage sustainable land management.

Supporting Afforestation in Desert Areas of China

Each spring, Korea suffers a great deal of climate-related damage due to the sandstorms from the deserts of northern China. Various afforestation projects are being carried out in China in order to combat the menace of the issue. In particular, the Kubuqi Desert in Inner Mongolia, China has an ongoing project that is held alongside various festivals to widely communicate the solutions between the two countries and foster friendship among youth. Since 2007, these projects, supported by the Korea Forest Service, have carried out afforestation over 1.998 million hectares of desert areas in China. The Korean Green Promotion Agency, Future Forests, the Communist Youth League of China, and Deoksan QI Administration of Inner Mongolia are just some of the participants of these operations.

Global Desertification Project

The recent global expansion of desertification, the Changwon Initiative was also joined by 137 country representatives and personnel from international organizations, NGOs, and local governments. The Tenth Session of the Conference of the Parties to the United Nations Convention to Combat Desertification (UNCCD COP 10) was the largest meeting of its kind with 3,000 NGOs, the Tenth Session of the Conference of the Parties to the United Nations Convention to Combat Desertification (UNCCD COP 10) was the largest meeting of its kind with 3,000 NGOs, the Tenth Session of the Conference of the Parties to the United Nations Convention to Combat Desertification (UNCCD COP 10) was the largest meeting of its kind with 3,000 NGOs, the Tenth Session of the Conference of the Parties to the United Nations Convention to Combat Desertification (UNCCD COP 10) was the largest meeting of its kind with 3,000 NGOs.