National Report on Sustainable Forest Management in Korea 2014

KOREA FOREST SERVICE

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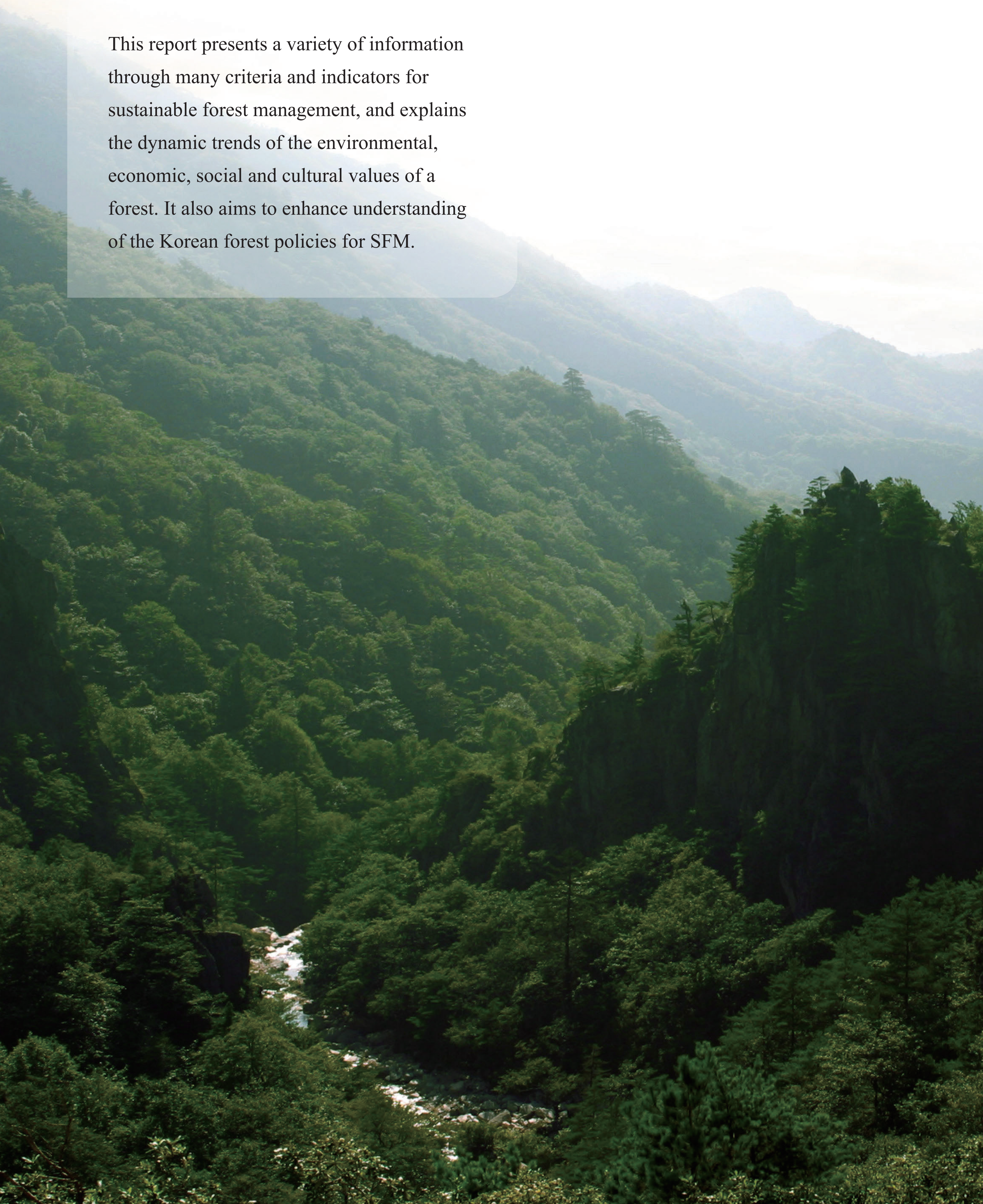
This report presents a variety of information through many criteria and indicators for sustainable forest management, and explains the dynamic trends of the environmental, economic, social and cultural values of a forest. It also aims to enhance understanding of the Korean forest policies for SFM.



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Foreword

I am pleased to release the second National Report on Sustainable Forest Management (SFM) in 2014, following the first report in 2009. This report explains the meaning and significance of criteria and indicators for SFM, and analyzes data trends of forests and forestry using 36 indicators out of 54 for the Conservation and Sustainable Management of Temperate and Boreal Forests (the Montreal Process). It also presents the national trends of the environmental, economic, social and cultural values of Korean forests.

The Republic of Korea has about 6.4 million hectares of forests. Only 10% of net growth volume is harvested annually for several decades resulting in rapid increase in average growing stock per ha, from 23 m^3 in 1981 to 125 m^3 in 2010. In addition, expansion of protected areas such as Baekdudaegan Reserves contributed to conservation of forest ecosystems and biodiversity.

Nevertheless, Korea still faces various challenges in forest management. In 2012, more than 7,500 hectares of forests were converted due to road construction or industrial site development, *etc*. Moreover, an age class imbalance has worsened - young forests have significantly shrunk while the number of mature stands has sharply increased. Other grave issues confronting the nation are fast-spreading pine wilt disease and oaks wilt disease, and worsening of soil acidification in forests. Working condition of forest workers also needs to be stabilized.

The criteria and indicators for SFM serve as an instrument to assess trends of forests objectively at the national level and to provide forest policy-makers with information needed to make the best decision possible. In this regards, it is necessary to advance the current system to collect more precise serial data related to each indicator and to assess conditions of Korean forests.

I think it is crucial to implement SFM at the national and international level in order to conserve forest ecosystem and to carry on socioeconomic activities in a sustainable manner. I look forward to vitalizing sustainable forest management through further developing scientific, technological, and institutional means of SFM best suited for forests and forestry in Korea.

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Executive Summary

The Montreal Process recommends publishing a national report on criteria and indicators for sustainable forest management (SFM) every five years in a voluntary base. Korea published the first national report on SFM in 2009, and this second national report in 2014 after a 5 year period is issued.

The 2009 national report on SFM in Korea collected and analyzed data for 29 indicators, based on the 7 criteria and 28 indicators chosen by the Korea Forest Service in 2005. This 2014 report analyzed of the significance and data trends on 36 indicators based on the 54 indicators of the Montreal Process (Table *i*). The remaining 19 indicators among the Montreal Process indicators were considered insufficient to apply in terms of data availability (Table *ii*). There is a need to further study on means of measuring and monitoring data for the 19 indicators not included in this national report so that they can be included in the future national reports.

A comparative evaluation between the reports of 2009 and 2014 was attempted to assess the progress on SFM in Korea, but the differences in the numbers of indicators applied, data sources and years of data collection imposed limitations to the direct comparisons. Thus, this summary report contains the changing trends on SFM in Korea for each indicator.

Criterion 1 Conservation of biological diversity

The Convention on Biological Diversity defines biodiversity as the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems. Biodiversity conservation is an essential element for SFM and the survival of the entire human communities. Biodiversity includes ecological diversity, species diversity and genetic diversity. Ecological diversity is assessed with Indicator <1-1> Area and percentage of forest by ecosystem type, successional stage, age class, and forest ownership, and Indicator <1-2> Area and percentage of protected forests by ecosystem type, age class or successional stage. Species diversity is assessed with Indicator <1-3> Number of forest associated species, Indicator <1-4> Number of forest associated species at risk as determined by legislation or scientific assessment, and Indicator <1-5> Status of on-site and off-site species conservation efforts. Genetic diversity is assessed with Indicator <1-6> Forest associate species at risk of losing genetic variation and locally adapted genotypes, Indicator <1-7> Genetic diversity of the representative forest associate species, and Indicator <1-8> Status of on-site and off-site genetic diversity conservation efforts.

Indicator 1-1. Area and percentage of forest by ecosystem type, successional stage, age class, and forest ownership

Forest areas are on a steady decrease since 1982, mainly due to the conversion of forests to industrial sites, road construction and housing development. During 2009 to 2013 the average conversion area was at 10,188 hectares per year, but after 2010 it continuously declined and reached at 7,432 hectares in 2013. The average growing stock per ha increased significantly from 23.09 m^3 in 1981 to 125.62 m^3 in 2010.

The forest areas by cover type are 2.6 million hectares of coniferous forests (40.5%), 1.7 million hectares of broadleaf forests (27.0%) and 1.9 million hectares of mixed forests (29.4%) in 2010. Compared to 1990, coniferous forests decreased by 498,000 hectares, whereas broadleaf and mixed forests increased by 330,000 hectares and 55,000 hectares, respectively.

In terms of the forest areas by ownership in 2010, national forests occupied approximately 1.54 million hectares accounting for 24.2% of the total forest area, whereas public and private forests occupied 488,000 hectares as 7.7% and 4.34 million hectares as 68.1%, respectively. Compared to 1995, national forests increased by 11% (151,000 hectares) whereas public and private forests decreased by 5% and 1%, respectively.

In terms of age class of forests, age class IV accounted for the highest proportion. age classes of I, II and III declined significantly whereas age classes of IV, V and VI increased sharply. The decline of young tree population appears to be a result of decreasing reforestation as well as elimination of trees damaged by pests and diseases and fires.

Indicator 1-2. Area and percentage of protected forests by ecosystem type, age class or successional stage

Expansion of protected areas and ensuring continuity are essential to sustaining and promoting biodiversity. The Convention on Biological Diversity recommended designating 17% of the global territory as protected areas by 2020. Korea has many overlapping protected areas from different conservation goals, so the proportion of protected areas over the total forest area will be calculated more accurately in the future.

Four sites were designated as UNESCO Biosphpere Reserves: Mt. Seoraksan (393.2 km^2), Jeju Island (831 km^2), Sinan-gun's archipelago of Jeonnam province (573.1 km^2, land area 145 km^2) and Gwangneung Forest (221 km^2). The Baekdudaegan Reserves accounts for 4% of the total forest area with an area of 274,000 hectares. The reserves was additionally expanded with an area of 11,000 hectares to the north of the Civilian Control Line (CCL) in 2013, annexed to the existing 263,000 hectares designated in 2005. The terrestrial areas of national parks are located in 17 sites with a total area of 3,902.5 km^2. The Forest Genetic Resources Reserves increased from 90,254 hectares of 251 sites in 2007 to 149,432 hectares of 599 sites in 2013. There are 55 Forest Genetic Resources Reserves registered on World Database on Protected Areas (WDPA) occupying 369,539 hectares. There are 9 ecosystem and landscape conservation reserves occupying 241.6 km^2, and 18 forest wetland protection reserves occupying 177.2 km^2.

Indicator 1-3. Number of forest associated species

The health of a forest ecosystem can be measured through the changes in the number of species within a natural forest. As of 2012 there are about 40,000 species living in Korean peninsular, of which 4,496 species of higher plants, 4,175 species of native plants, 321 species of naturalized plants, 14,297 species of insects, 3,413 species of fungus, 691 species of lichen, 519 species of birds and 125 species of mammals are reported.

Indicator 1-4. Number of forest associated species at risk as determined by legislation or scientific assessment

The information on the number and status of species at risk of extinction or serious decline is a critical indicator to measure the soundness of a forest ecosystem. As of 2012 there are 246 species at risk of extinction in total, increased from 221 species in 2005. 51 species of them, increased from the previous 50, are Extinction Risk Class I and 195 species, increased from the previous 171, are Extinction Risk Class II.

Under the Forest Protection Act since 2012, Korea Forest Service (KFS) has designated and managed the specially protected species which are either particularly vulnerable to climate change, forest disaster or human induced damage, or high in economic, cultural, and academic values.

Indicator 1-5. Status of on-site and off-site species conservation efforts

Forest species often face decline or extinction, therefore it is necessary to conserve them by human intervention. On-site and off-site species conservation efforts are conducted according to the Forest Bio-resources Implementation Plan, and the results are published on the Forest Bio-resources Implementation Report, in which presents the annual progress on biodiversity conservation efforts.

A total of 1,036,056 samples of 20,951 species are conserved off-site for biodiversity, and 287 species of rare and special plants are conserved on-site and used for restoration studies.

Indicator 1-6. Forest associate species at risk of losing genetic variation and locally adapted genotypes

The loss of genetic variation within a species reduces its adaptability to the future environmental changes and increases the risk of extinction. One third of *Abies koreana*, a local species of Jeju, has been observed to disappear from Mt. Hallasan.

Indicator 1-7. Genetic diversity of the representative forest associate species

Certain forest species lead or play a role of shifting forest structure, shape, or succession. The genetic diversity of such species represents the status of forests. The genetic diversity and group genetic structure were analyzed using biomarker methods on 128 groups of 12 conifer species and 105 groups of 13 broadleaf species.

Indicator 1-8. Status of on-site and off-site genetic diversity conservation efforts

Forest species may face at risk from loss of genetic variation as the population or habitats decline. KFS manages 599 Forest Genetic Resources Reserves with a total area of 149,432 hectares as of 2013 to conserve on-site genetic diversity.

Criterion 2 Maintenance of productive capacity of forest ecosystems

Productive capacity of forest ecosystems shows the potential availability of forests to directly or indirectly provide a wide range of goods and services. Annual harvest of wood and non-wood products should not exceed annual growth in an eco-friendly and sustainable way which makes the productivity of forests maintained and able to reproduce in perpetuity. Thus, preventing the depletion of wood and non-wood products from external interferences through the implementation of SFM is essential to maintain forest productive capacity.

Forest productivity is assessed with the following four indicators: Indicator <2-1> Area and percent of forest land and net area of forest land available for timber production, Indicator <2-2> Total growing stock and annual growth volume by forest type in the net area of forest land available for timber production, Indicator <2-3> Area and growing stock of plantations of native and exotic species and Indicator <2-4> Annual wood harvest by volume and as a percentage of net growth.

Indicator 2-1. Area and percent of forest land and net area of forest land available for timber production

This indicator provides information on estimating the current productive capacity of forests to produce wood. It shows the availability of forest land for wood production with respect to the total forest area in Korea. Of the total forest of 6.37 million hectares, the working forest area of 4.86 million hectares, which is 76.3% of the total forest land, is considered available to timber production in 2010, and the area was more or less the same in comparison to that of 1985. In the working forest areas, age class I, II, III stands are declining whereas those of age class IV, V, VI are significantly increasing.

Indicator 2-2. Total growing stock and annual growth volume by forest type in the net area of forest land available for timber production

The total growing stock of forests available for timber production is at 626 million m^3, and the total working forest area of 4.86 million hectares shows an average growing stock of 129 m^3 per hectare. Compared to the total growing stock of 229 million m^3 in 1995, the working forest area has grown 26.5 million m^3 in an annual average during the last fifteen years. By converting it to an annual growth volume per ha in the working forest area, it appears to have an annual average growth of 5.4 m^3 per ha. The annual timber harvest volume in 2010 was 3.72 million m^3, which was only about 14% of the annual growth volume of 26.5 million m^3 in average. It appears to be only a very small portion of the annual timber production capacity.

Indicator 2-3. Area and growing stock of plantations of native and exotic species

This is an indicator to measure the extent of plantations managed by entities in charge of national, public and private forests to satisfy the market demand on the rise. Intensively managed plantations may help relieve pressures on natural forests. Looking at the current reforestation trends, for conifers *Pinus densiflora* as a local species and *Chamaecyparis obtusa* as an exotic species have been planted most, and for broadleaves *Quercus acutissima* as a local species and *Betula platyphylla* var. *japonica* as an exotic species have been planted most. Statistics on the annual plantation species and growth volume status from the Statistical Yearbook of Forestry by KFS has imposed limitations on calculating the area and growing stock of local and exotic species by each species due to its species classification divided into ‘other conifers’ and ‘broadleaf plantations’ in sub-total except for *Larix kaempferi* and *Pinus rigida*.

Indicator 2-4. Annual wood harvest by volume and as a percentage of net growth

This indicator evaluates whether the productive capacity of forests is maintained in the concept of sustained yield of timber with respect to the net growth volume versus the annual allowable cut (AAC). The amount of wood production over the net growth volume is consistently increasing, but only amounting to a small proportion of 10% or so as of 2010.

Criterion 3 Maintenance of forest ecosystem health and vitality

Maintaining the health and vitality of forest ecosystems is essential to SFM. In particular, indiscreet human disturbances to forest ecosystems undoubtedly bring negative impacts on the health and vitality of forests such as introduction of invasive species and pests and diseases. This criterion seeks to assess the extent of damages from biotic and abiotic causes such as pests and diseases, forest fires and landslides which adversely affect the health and vitality of forest ecosystems.

The health and vitality of forest ecosystems are assessed with the following two indicators: Indicator <3-1> Forest area affected by biotic processes and agents (forest pests and diseases) and Indicator <3-2> Forest area affected by abiotic causes (fire, typhoon and landslide).

Indicator 3-1. Forest area affected by biotic processes and agents (forest pests and diseases)

The four major pests and diseases in Korea are *Bursaphelenchus xylophilus* (Pinewood nematode), *Thecodiplosis japonensis* (Pine needle gall midge), *Matsucoccus thunbergianae* (Black pine bast scale), *Raffaelea quercus-mongolicae* (Oak wilt).

Since the occurrence of *Bursaphelenchus xylophilus* (Pinewood nematode) in 1988, the damaged areas by pine wilt disease began to decrease from 2005, but after 2012 climate factors such as high temperature and draught, combined with human factors such as neglection of dead trees and arbitrary moving of infested trees, are driving up the damage again. *Raffaelea quercus-mongolicae* (Oak wilt) took place in Seongnam, Gyeonggi-do in 2004, and began to decline after peaking in 2008, but after 2011 a significant level of damage centered around the metropolitan Seoul and Chungbuk-do areas and the disease is spreading and concentrating itself to the outer metropolitan Seoul area.

Indicator 3-2. Forest area affected by abiotic causes (fire, typhoon and landslide)

In 2012 197 of forest fires damaged a total of 72 hectares, but it was a major decline as it was only 46% and 6% of the annual average incidence and damaged area between 2003 to 2012, respectively, during which 387 incidences occurred damaging 734 hectares in an annual average. In terms of the causes of fires, the majority was human induced mistakes, of which accidental burning was 16% (agricultural field burning 9% and trash incineration 7%) and accidental fires by hikers 42%. The total landslide area in 2012 was 491 hectares, which was about 40% reduction from 824 hectares in 2011 and at 88% of the annual average occurrence of 558 hectares from 2003 to 2012.

Criterion 4 Conservation and maintenance of soil and water resources

Soil and water resources are essential components of terrestrial ecosystems. Soil shelters plants and animals, provides water and nutrition and filters pollutants. Water consists more than 75% of all living organisms, serves as a solvent and plays a role of transport passage. Thus, soil and water significantly affect the lives of both humans and wildlife; their quantity and quality have a substantial impact on the structure of a forest ecosystem and determine its socioeconomic values accordingly.

The status of soil and water conservation is assessed with the following four indicators: Indicator <4-1> Designated forest area for conservation of soil and water resources, Indicator <4-2> Erosion control achievements to protect forest soil resources, Indicator <4-3> Area and proportion of forest land with soil degradation, and Indicator <4-4> Forest management activities to protect water resources.

Indicator 4-1. Designated forest area for conservation of soil and water resources

Because 64% of the Korean territory is comprised of forests, the majority of water resources rises from the forests. In other words, forests retain water from precipitation and release it back to reservoirs and rivers, serving as a water source. Disaster prevention reserves for soil protection, watershed conservation forests for water protection and water protection zones to protect source of water in upstream have been designated and specially cared.

Disaster prevention reserves were up to 367,000 hectares in 1970, but after completion of consistent reforestation and wasteland restoration most of them released from disaster prevention reserves, and only 5,000 hectares remains as of 2012. Watershed conservation forests slightly decreased from 282,000 hectares in 1970 to 269,000 hectares in 2012. Water protection zones to protect upstream water sources fluctuated a little between 131,000 hectares in 1988 and 119,000 hectares in 2012, but have been maintaining around 120,000 hectares.

Indicator 4-2. Erosion control achievements to protect forest soil resources

Erosion control is a representative forest management activity for soil protection, and includes all activities that stabilize and restore forest soil where there is at high risk of loss of surface soil.

The traditional means of erosion control is the hillside erosion control. Since the preventive erosion control was introduced in 1996, two types of erosion control projects are in progress at the moment. In the 1970s, up to a minimum of 5,000 hectares of the hillside erosion control was performed. Since then the annual control area stays at an average of 86 hectares in the 2000s. The preventive erosion control aims to prevent or minimize damage from soil erosion by landslides. The preventive erosion control projects have been on a steady rise since its introduction, and were performed across 48 hectares in 2012.

Indicator 4-3. Area and proportion of forest land with soil degradation

Forest fires, illegal forest activities and landslides are main factors that cause degradation of physical properties of forest soils. The average damaged area by forest fires was 733.9 hectares per year from 2003 to 2012. Forest damage from illegal means has occurred up to 552.6 hectares in an annual average from 2003 to 2012. The total damaged areas by landslides caused from typhoon and heavy rain have accumulated up to 10,000 hectares of forests and 540 km of streams since 1997.

Soil acidification is one of indicators representing the changes in the chemical properties of forest soils. In the past fifteen years from 1996 to 2010, broadleaf forests dropped from pH 5.39 to pH 5.16, and conifer forests from pH 4.92 to pH 4.75, indicating the worsening soil acidification in forests.

Indicator 4-4. Forest management activities to protect water resources

The torrent erosion control, forest watershed management and forest tending are the representative forest management activities to protect and increase water resources.

The torrent erosion control gained momentum in the early 1970s from the initial mountain erosion control programs; in 1972 alone, the torrent erosion control was performed in 271 km long. Since then it sharply declined afterward. However, the torrent erosion control projects are on the rise again, spearheaded by the construction of erosion control dams after the landslide incident at the Mt. Woomyeonsan in Seoul in 2011. In 2012 439 km of the torrent erosion control was implemented. Since the forest watershed management program was first introduced in 2004, the number of projects continued to rise again, peaked with 27 sites in 2007 and 18 sites in 2012.

Forest tending practices such as thinning and pruning promote decomposition of organic compounds in the soil by improving its light exposure conditions, particularly in conifer forests; in turn they promote growth of herbaceous plants and lower layer vegetation, improve physical conditions of the soil and increase water retention capacity of the soil. Up to 2002 forest tending practices covered an area under 50,000 hectares, and expanded to 170,000 hectares in 2003 and 250,000 hectares in 2012. Forest tending programs are expected to consistently increase in order not only to promote the public benefits of forests such as water retention but also to create economic forests and conserve biodiversity.

Criterion 5 Maintenance of forest contribution to global carbon cycles

Forests play an important role of carbon sinks and sources in global carbon cycles. Carbon stocks of forests include biomass (stems, floor leaves and branches, woody debris, roots, dry standing stems), soil carbon pools, and forest products. The Korean forests occupy 64% of the territory and function as a major carbon sink to absorb CO_2 in the air. They are expected to contribute to greenhouse gas emission reduction.

Forest contribution to global carbon cycles is currently assessed with two indicators: Indicator <5-1> Total carbon stocks in forest biomass and Indicator <5-2> Carbon budget of forest biomass. The ‘Total forest product carbon pools and fluxes’ and ‘Avoided fossil fuel carbon emissions by using forest biomass for energy’ in the Montreal Process criteria and indicators remain to be further studied.

Indicator 5-1. Total carbon stocks in forest biomass

As of 2010 the total carbon stock in the forest biomass of Korea amasses up to 429,289 thousand tC, composed of 33% of conifer forests, 35% of broadleaf forests and 32% of mixed forests. It is a 3-fold increase since 1990.

Indicator 5-2. Carbon budget of forest biomass

As of 2010 the annual CO_2 total removals from forest biomass growth is approximately 68,193 thousand tCO_2, and the annual CO_2 emission from activities such as logging 8,518 thousand tCO_2. Thus the annual CO_2 net removals of forests is 59,675 thousand tCO_2. It is a 1.7-fold increase from 1990.

Criterion 6 | Maintenance and enhancement of socioeconomic benefits of forests to meet the needs of societies

Sustaining and improving forest ecosystems through SFM make forests enable to continuously provide a wide range of socioeconomic goods and benefits. Criteria 1 to 5 focus on the sustainability of forests in ecological and environmental aspects, while Criterion 6 focuses on the sustainability of forests in economic and social aspects. Criterion 6 of the Montreal Process divides into 5 sub-criteria and 20 indicators. However, this report includes only 9 indicators nationally measurable in Korea. These indicators are: Indicator <6-1> Value and quantity of wood and wood products, Indicator <6-2> Value and quantity of non-wood forest products, Indicator <6-3> Consumption of wood and wood products, Indicator <6-4> Consumption of non-wood forest products, Indicator <6-5> Employment and income in forestry sector, Indicator <6-6> GDP and forest sector GDP, Indicator <6-7> The mountain village experience programs: number of visitors and annual income, Indicator <6-8> Area and proportion of forests managed for public recreation and tourism and Indicator <6-9> Number of visitors by type of forest recreation.

Indicator 6-1. Value and quantity of wood and wood products

This indicator measures the economic scale of the Korean forestry and timber industries by examining value and production of timber and wood products.

The amount of domestic wood supply was merely 1 million m^3 until the 1990s, but steadily increased to 4.5 million m^3 in 2012.

Fiberboard was first produced in Korea in 1984. Increased production of coniferous trees from thinning after 1997 by the national forest tending program drove up the fiberboard production since 2005, reaching 1.7 million m^3 in 2012.

Due to the hardwood export restrictions from the south east Asian countries in the 1980s, raw material for plywood production was substituted to conifers in the 1990s. However, the amount of domestic production of plywood continued to decline from 1.5 million m^3 in 1980 to 0.43 million m^3 in 2012.

Particle board production began 1960 but its level of production remained meager until 1990s. After 2000 it increased to 700,000 to 900,000 m^3 per year.

Pulp production increased 3.4 fold from 167,000 tons in 1980 to 562,000 tons in 2012. Among them chemical pulp accounts for 80% and mechanical pulp 20%.

Paper production doubled from 2.61 million M/T in 1985 to 5.11 million M/T in 1990. After 2000 it exceeded 10 million M/T. In 2012 it was at 11.3 million M/T, a slight decrease by 158,000 M/T compared to that of 2011. The major paper products in 2012 were as follows: container board 36%, printing paper 28% and newspaper 13%.

Indicator 6-2. Value and quantity of non-wood forest products

The total production value of forest products in 2012 was 423.9 billion Won, 91.6% of which came from non-wood forest products, amounting to 388.1 billion Won, and it has been sharply increasing.

- Nuts and Fruits: (1980) 45,500 tons, 45.9 billion Won → (2012) 189,400 tons, 761.9 billion Won
- Mushrooms: (1980) 1,500 tons, 16.4 billion Won → (2012) 26,300 tons, 287.1 billion Won
- Wild vegetables: (1980) 1,500 tons, 0.9 billion Won → (2012) 46,000 tons, 388.6 billion Won
- Medicinal plants: (1980) 1,100 tons, 1.6 billion Won → (2012) 18,700 tons, 384.5 billion Won

Indicator 6-3. Consumption of wood and wood products

This indicator presents consumption and supply of wood and wood products in Korea.

Wood consumption increased from 21,746 thousand m^3 in 1990 to 27,970 thousand m^3 in 2000, but the self sufficiency of wood remained at about 15%, depending largely on imported wood and wood products. Per capita wood consumption has not changed much from 0.51 m^3 in 1990 to 0.55 m^3 in 2012.

Roundwood consumption increased from 7,154 thousand m^3 in 1980 to 8,192 thousand m^3 in 2012, 4,506 thousand m^3 of which was from domestic supply, accounting for about 55% of the entire consumption of roundwood.

Particle board consumption has increased steadily because of its diverse use for kitchen and office furnitures. Its consumption rose sharply from 23,000 m^3 in 1980 to 1,513,000 m^3 in 2012, 49% of which was supplied by imported particle boards.

Fiberboard consumption increased from 34,000 m^3 in 1985 to 1,957,000 m^3 in 2010, but took a downturn to 1,615,000 m^3 in 2012. It was a consecutive drop for 2 years since 2010. It appears to be caused by decreasing demand for furniture, flooring and interior materials due to a prolonged recession of the construction market in Korea.

Plywood consumption decreased sharply as it was replaced with particle board and fiberboard since the late 1980s. It dwindled to 1,625 thousand m^3 in 2012 from 1,901 thousand m^3 in 2005, 75% of which was imported.

Pulp appears to have a demand around 3,000 tons after 2000, 80% of which is imported.

Indicator 6-4. Consumption of non-wood forest products

This indicator shows the consumption trend of the major non-wood products such as chestnut, pine nut, jujube, walnut, and oak mushroom.

Chestnut production peaked around 129.7 thousand tons in 1997 but dwindled to 62.3 thousand tons in 2012. Chestnut consumption also declined to 63.1 thousand tons in 2012 from 103.5 thousand tons in 1997.

Pine nut production reached 6,720 tons in 2010 but decreased to around 1,500 tons per year afterward. Its consumption remains at a similar level of its production at about 1,600 tons.

Jujube production peaked at 13,969 tons in 1996. Since then it gradually declined up to 6,645 tons in 2003. By the end of 2012 it increased to 9,509 tons. Its consumption remains at approximately 9,400 tons on a yearly average, slightly above the average amount of production in the past 5 years.

Walnut consumption increased from 2,128 tons in 1992 to 12,464 tons in 2006. As its import from USA increased sharply the consumption level also rose to 17,455 tons in 2012. Since the amount of domestic walnut production is merely 1,000 tons more or less, most of the demand relies on the import.

Oak mushroom production is on a steady rise from 1,034 tons in 1986, reaching 4,367 tons in 2012. In addition to this, its import from China increased from 1,372 tons in 1997 to 3,494 tons in 2012. The consumption of oak mushrooms increased from 974 tons in 1990 to 7,718 tons in 2012.

Indicator 6-5. Employment and income in forestry sector

Employment and income in forest sector reflect the working conditions and the status of forestry labour market.

As of 2012, the annual average days of employment for forest workers showed a low stability of employment as it was 179 days in the national forest work groups and 129 days in the private forest work groups.

In 2012 the annual average income for forest workers was 40,771 thousand Won in the national forest work groups which was a steady increase from the past, but only 29,006 thousand Won in the private forest work groups, showing a large income disparity between the two sectors.

The annual average wage for wood and wood products manufacturing worker (C16) increased by 1.1 million Won in 2012 to 27.7 million Won from 26.6 million Won in 2011.

The annual average wage for paper and paper products manufacturing worker (C17) increased by 1.3 million Won in 2012 to 32.6 million Won from 31.3 million Won in 2011.

Indicator 6-6. GDP and forest sector GDP

The real GDP of Korea in 2012 was 1,104 trillion Won, and that of forestry 1.3644 trillion Won, contributing only 0.1% of the total GDP. On the contrary, GDP all together from the “wood and wood products manufacturing sector”, the “pulp and paper manufacturing sector” and the “furniture and other product manufacturing sector” accounted for 0.9% of the overall GDP of Korea, with a total of 10.142 trillion Won in 2012.

Indicator 6-7. The mountain village experience programs: number of visitors and annual income

This indicator provides information on how the mountain eco-villages as forest-dependent communities have reacted to the changing socioeconomic conditions in terms of sustaining livelihood, income, improving quality of life, cultural identity and overall well-being.

The result of a survey across 30 mountain eco-villages running mountain village experience programs revealed that the number of visitors in 2006 decreased by 13% in comparison to the previous year but the total income increased by 23%, and the number of visitors in 2007 increased by 8% in comparison to the previous year and so did the total income by 19%. Overall, mountain village experience programs appear to make a positive contribution to the local forest-dependent communities.

Indicator 6-8. Area and proportion of forests managed for public recreation and tourism

The proportion of forests designated for recreation with respect to the total forest area reflects to what extent each country recognizes the importance of forest recreation and tourism.

The area of forests for recreation and tourism is 665,000 hectares, accounting for 6.64% of the total territory and 10.36% of the total forest area.

Indicator 6-9. Number of visitors by type of forest recreation

This indicator provides information on the types and levels of leisure and tourism activities in forests. In 2013 the number of users for forest recreation mounted up to 406 million people. The shift of forest recreation activities from 'peak-conquering' to 'horizontal leisure' led to wider forms of participation with 400,000 people on forest trails, 310,000 people using healing forests, 500,000 youth benefitting from forest education and 430,000 children enjoying forest-for-kids programs.

Criterion 7 Legal, institutional, and economic frameworks for sustainable forest management

Criterion 7 includes qualitative indicators related to legal, institutional and economic frameworks for sustainable forest management. The indicators used are as follows: Indicator <7-1> Laws and policies supporting sustainable forest management, Indicator <7-2> Taxation and economic strategies that affect sustainable forest management, Indicator <7-3> Clarity and security of land and resource ownership and property rights, Indicator <7-4> Enforcement of forest-related laws, Indicator <7-5> Programs, services, and other resources to support sustainable forest management, Indicator <7-6> Development and application of research and technologies for sustainable forest management and Indicator <7-7> Public participation and dispute resolution in forest-related decision making.

Indicator 7-1. Laws and policies supporting sustainable forest management

Laws and policies on forests are set to reflect the diverse social, economic and environmental needs of the public. However, they may restrict or regulate forest management activities of a forest owner, but since they form a basis for implementing SFM, they ultimately play an important role of ensuring sustainability for forest management activities.

The Framework Act on Forest declares SFM as the basic principle of forest management, and stipulates the criteria and indicators for its assessment. The 4th National Forest Plan established the policy and institutional arrangements for implementation of SFM, and the 5th National Forest Plan from 2008 to 2017 sets a vision of Korea forest as an accomplishment of sustainable green well-being country.

Indicator 7-2. Taxation and economic strategies that affect sustainable forest management

Forest management involves an unusually long payback period and a high risk of investment because it is always exposed to potential damage from natural disasters. However, with respect to the public benefits supplying clean water and fresh air as well as the economic benefits generated from forests, direct support through loans or capital investments and indirect aid through tax incentives are required to alleviate the long duration of risks inherent in forest investments and to motivate forest owners to invest in forestry projects. In order to promote SFM, the government has provided many forms of supporting policies such as tax relief schemes and low-interest rate loans.

Indicator 7-3. Clarity and security of land and resource ownership and property rights

Protection of property rights, exercise of rights and dispute resolution for forests are essential for SFM. When a transfer of ownership occurs following acquisition and status change of a real estate, it must be registered in compliance with the "Civil Law and Real Estate Registration Act" in order to ensure property rights.

In terms of forest ownership registration, forest areas are divided into 1,543 thousand hectares of national forests, 487,000 hectares of public forests and 4,338 thousand hectares of private forests, totalling to 6,368 thousand hectares.

Indicator 7-4. Enforcement of forest-related laws

Respective forestry associated offices under the central and local governments combine their administrative efforts to guide, supervise and enforce the laws and regulations pertaining to forest management. Policing power is also given to some of the forestry officials under the central or local government in order to monitor and control illegal logging, illegal forest damages and forest fires.

Indicator 7-5. Programs, services, and other resources to support sustainable forest management

Acquisition of professional knowledge and technical training must be systematically conducted to implement SFM. KFS operates 15 types of forestry information systems such as GIS system, mobile field operation system and forest project management system, *etc.* to support forest officers in charge of national or private forest management. The National Forestry Cooperative Federation has founded the Institute of Forestry Technology and the Institute of Forestry Machinery to train professional forestry engineers.

Indicator 7-6. Development and application of research and technologies for sustainable forest management

This indicator explains the research, technical development and their application to SFM, using SFM-related studies and other studies undertaken by KFRI and in association with the Jeju Experimental Forest as a test site for SFM.

Indicator 7-7. Public participation and dispute resolution in forest-related decision making

It is important to build legal and institutional mechanisms to ensure the participation of stakeholders in forestry and the general public in the decision making process of forest policies. A healthy level of social participation promotes the understanding of general public related to forest policies and management activities, and in turn it can lead to a wide range of public support and cooperation for SFM.

[Table *i*] **Indicators reported in 2009 versus 2014**

Criteria	29 Indicators in the 2009 National Report	36 Indicators in the 2014 National Report
1. Conservation of biological diversity	1-1. Area and percentage of forest ecosystem type, successional stage, age class, and forest ownership or tenure	1-1. Area and percentage of forest by ecosystem type, successional stage, age class, and forest ownership
	1-2. Area and percentage of forest in protected areas by forest ecosystem type and by age class or successional stage	1-2. Area and percentage of protected forests by ecosystem type, age class or successional stage
	1-4. Number and population levels of native forest-associated species	1-3. Number of forest associated species
	1-5. Number and status of native forest associated species at risk as determined by legislation or scientific assessment	1-4. Number of forest associated species at risk as determined by legislation or scientific assessment
		1-5. Status of on-site and off-site species conservation efforts
		1-6. Forest associate species at risk of losing genetic variation and locally adapted genotypes
		1-7. Genetic diversity of the representative forest associate species
	1-6. Status of on-site and off-site efforts focused on conservation of genetic diversity	1-8. Status of on-site and off-site genetic diversity conservation efforts
2. Maintenance of productive capacity of forest ecosystems	2-1. Area of forest land and net area of forest land available for timber production	2-1. Area and percent of forest land and net area of forest land available for timber production
		2-2. Total growing stock and annual growth volume by forest type in the net area of forest land available for timber production
	2-2. Area and growing stock of plantations of native and exotic species	2-3. Area and growing stock of plantations of native and exotic species
	2-3. Annual harvest of wood products and net growth	2-4. Annual wood harvest by volume and as a percentage of net growth
	2-4. Forest area covered by management plans	

Criteria	29 Indicators in the 2009 National Report	36 Indicators in the 2014 National Report
3. Maintenance of forest ecosystem health and vitality	3-1. Area and percentage of forest affected by processes or agents beyond the range of historic variation	3-1. Forest area affected by biotic processes and agents (forest pests and diseases)
	3-2. Area and percentage of forest land subjected to levels of specific air pollutants (e.g. sulfates, nitrate, and ozone) or acid precipitation that may cause negative impacts on the forest ecosystem	3-2. Forest area affected by abiotic causes (fire, typhoon and landslide)
4. Conservation and maintenance of soil and water resources	4-5. Protected forests	4-1. Designated forest area for conservation of soil and water resources
		4-2. Erosion control achievements to protect forest soil resources
	4-1. Area and percentage of forest land with significant soil erosion	4-3. Area and proportion of forest land with soil degradation
	4-3. Area and percentage of forest land with significant compaction or change in soil physical properties resulting from human activities	
		4-4. Forest management activities to protect water resources
	4-2. Area and percentage of forest land with significant diminished soil organic matter and/or changes in other soil chemical properties	
	4-4. Percentage of water bodies in forest areas with significant variation from the historic range of variability in pH, dissolved oxygen, levels of chemicals, sedimentation, and temperature	
5. Maintenance of forest contribution to global carbon cycles	5-1. Total forest ecosystem biomass and carbon pool	5-1. Total carbon stocks in forest biomass
	5-2. Contribution of forest ecosystem to the total global carbon budget	5-2. Carbon budget of forest biomass
6. Maintenance and enhancement of socioeconomic benefits of forests to meet the needs of societies	6-1. Value and volume of wood and wood products, including value added through downstream processing	6-1. Value and quantity of wood and wood products
	6-2. Value and quantity of non-wood forest products	6-2. Value and quantity of non-wood forest products
	6-3. Supply and consumption of wood and wood products	6-3. Consumption of wood and wood products
	6-4. Supply and consumption of non-wood forest products	6-4. Consumption of non-wood forest products

Criteria	29 Indicators in the 2009 National Report	36 Indicators in the 2014 National Report
6. Maintenance and enhancement of socioeconomic benefits of forests to meet the needs of societies		6-5. Employment and income in forestry sector
	6-5. Value of wood and non-wood products as percentage of GDP	6-6. GDP and forest sector GDP
		6-7. The mountain village experience programs: number of visitors and annual income
	6-6. Area and percentage of forest land managed for general recreation and tourism In relation to the total area of forest land	6-8. Area and proportion of forests managed for public recreation and tourism
		6-9. Number of visitors by type of forest recreation
7. Legal, institutional and economic framework for sustainable forest management	7-1. Clarifies property rights, provides appropriate land tenure arrangements, recognizes customary and traditional rights of indigenous people, and provides a means of resolving property disputes by process	7-1. Laws and policies supporting sustainable forest management
	7-2. Provides periodic forest-related planning, assessment, and policy review that recognizes the range of forest values, including coordination with relevant sectors	7-2. Taxation and economic strategies that affect sustainable forest management
	7-3. Provides opportunities for public participation in public policy and decision making related to forest and public access to information	7-3. Clarity and security of land and resource ownership and property rights
	7-4. Undertake and implement periodic forest-related planning, assessment, and policy review, including cross-sectoral planning and coordination	7-4. Enforcement of forest-related laws
	7-5. Provides public involvement activities and public education awareness and extension programs, and make available forest-related information	7-5. Programs, services, and other resources to support sustainable forest management
		7-6. Development and application of research and technologies for sustainable forest management
		7-7. Public participation and dispute resolution in forest-related decision making

[Table *ii*] List of Montreal Process indicators not sufficient for reporting in Korea

Criteria	Indicators
1. Conservation of biological diversity	1.1.c Fragmentation of forests
2. Maintenance of productive capacity of forest ecosystems	2.e Annual harvest of non-wood forest products
3. Maintenance of forest ecosystem health and vitality	-
4. Conservation and maintenance of soil and water resources	4.3.b Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical or biological properties from reference conditions
5. Maintenance of forest contribution to global carbon cycles	5.b Total forest product carbon pools and fluxes 5.c Avoided fossil fuel carbon emissions by using forest biomass for energy
6. Maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of societies	6.1.c Revenue from forest based environmental services 6.1.f Value and volume in round wood equivalents of exports and imports of wood products 6.1.g Value of exports and imports of non-wood forest products 6.1.h Exports as a share of wood and wood products production and imports as a share of wood and wood products consumption 6.1.i Recovery or recycling of forest products as a percent of total forest products consumption 6.2.a Value of capital investment and annual expenditure in forest management, wood and non-wood forest product industries, forest-based environmental services, recreation and tourism 6.2.b Annual investment and expenditure in forest-related research, extension and development, and education 6.3.d Area and percent of forests used for subsistence purposes 6.3.e Distribution of revenues derived from forest management 6.5.a Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and values 6.5.b The importance of forests to people
7. Legal, institutional and economic frameworks for forest conservation and sustainable management	7.1.b Cross sectoral policy and programme coordination 7.5.a Partnerships to support the sustainable management of forests 7.5.c Monitoring, assessment and reporting on progress towards sustainable management of forests

Introduction

The 1992 UN Conference on Environment and Development (UNCED) brought forth a paradigm shift for the global environment. Under the new concept of sustainable development, a reconciliation effort was attempted at shifting the view on environment and development from an existing opposition to compatibility. The Forest Principles and Agenda 21, adopted by the UNCED, recommended that SFM be carried out by formulating guidelines of internationally agreed scientific methodologies and criteria in order to match its forest management to the spirit of sustainable development. The Forest Principles Element 2(b) defines SFM as "Forests should be sustainably managed to meet the social, economic, ecological, cultural and spiritual human needs of present and future generations."

The paradigm of forest management has been changing over time. A conventional timber management as a sustained yield of timber changed to the concept of multiple use management to make full use of direct and indirect utilities of a forest from the 1940s. Since the 1990s, it has evolved to a concept of forest ecosystem management for SFM. It implies the pursuit of an integrating system that manages forest resources not only for the economic and social needs but also for the ecological stability.

The objective evaluation of forest sustainability has emerged as an important issue along the international efforts to put SFM into effect. Since 1993 regional initiatives such as the Montreal Process centered around the Asia-Pacific rim countries and the Helsinki Process (Forest Europe) have been launched to develop the criteria and indicators for SFM.

The Montreal Process is a voluntary regional initiative with twelve member countries: Korea, China, Japan, Russia, Australia, New Zealand, USA, Canada, Mexico, Argentina, Chile, Uruguay. These 12 countries account for 83% of the world's temperate and boreal forests, 49% of the world's forest areas, 33% of the world's population and 40% of the world's wood products. In 1995, the Montreal Process adopted the Santiago Declaration and seven criteria and 67 indicators to implement SFM at the sixth Working Group meeting in Santiago, Chile. Afterward the Montreal Process revised the quantitative 47 indicators of criteria 1-6 to 44 in 2006, and the qualitative 20 indicators of criteria 7 to 10, which make up 54 indicators in total to evaluate the implementation of SFM. Here, criterion is a group of indicators periodically monitored to assess changes in forests, and indicators are quantitative or qualitative variables regularly measured and monitored to show the trends in forests.

The Montreal Process identified seven criteria as the essential elements of conservation and sustainable management of temperate and boreal forests. They are defined by measurable or explainable indicators. The criteria and indicator are not set in a particular order or priority, and hold equal importance.

The indicators in the criteria 1-6 are the quantitative indicators with respect to the multilateral values and benefits associated with the health of a forest as well as the environmental, social and economic goods and services that forests provide. The indicators in the criterion 7 are qualitative indicators associated with the legal, institutional and economic frameworks set to promote SFM.

The criteria and indicators of the Montreal Process promote understanding on the significance of SFM. They are a means to assess the national trends in forest condition and its management, and provide a common framework to monitor, assess, and report the progress of forest sustainability at the national level.

Application of the criteria and indicators for SFM will provide forest policy makers with a basis for the best decision making, and serve as a tool to inform the public the status and trends of forests. These criteria and indicators also improve the scientific knowledge pertaining to the functions of forest ecosystems and how they respond to human interference, help us accumulate the ability and experience of measuring indicators and guide to reflect the changes in demand for wood products and forest services.

The first national report of Korea, the National Report on Sustainable Forest Management in Korea 2009, performed data collection and analysis for 29 indicators, which were based on the 28 indicators of the seven criteria chosen by the KFS. Five years later, this report explained the meaning and significance of each indicator and analyzed the data trends for 36 indicators out of the 54 indicators of the Montreal Process. In explaining the data status and trends, numbering of indicators in each heading of indicators was displayed together with the numbering of Montreal Process indicators to make them comparative.

Due to a lack of data availability 19 indicators out of the 54 Montreal Process indicators were unable to be included for reporting. While it was possible to collect data for many of the Montreal Process indicators, some of them are required new or additional studies for data collection. Therefore, there is a need to study means of measuring and monitoring data for the 19 indicators not included in this national report so that they can be measured and included in the future national reports.

National Report on Sustainable Forest Management in Korea 2014

Criteria and indicators for sustainable forest management in Korea

Temple Forest in Gyungsangnam-do(Chun, Jung Hwa)

Criterion 1 Conservation of biological diversity

Indicator 1-1	Area and percentage of forest by ecosystem type, successional stage, age class, and forest ownership
Indicator 1-2	Area and percentage of protected forests by ecosystem type, age class or successional stage
Indicator 1-3	Number of forest associated species
Indicator 1-4	Number of forest associated species at risk as determined by legislation or scientific assessment
Indicator 1-5	Status of on-site and off-site species conservation efforts
Indicator 1-6	Forest associate species at risk of losing genetic variation and locally adapted genotypes
Indicator 1-7	Genetic diversity of the representative forest associate species
Indicator 1-8	Status of on-site and off-site genetic diversity conservation efforts

Conservation of biological diversity

Covering 64% of the total land area, forests in Korea are essential for the management and sustainable use of natural resources and for the conservation of biological diversity. Over the last four decades, forest ecosystems have been significantly restored through comprehensive efforts such as rehabilitation of degraded forest lands, expansion of protected areas and implementation of SFM.

Following the large-scale plantations and rehabilitation of degraded forests in the 1970s and 1980s and over the course of natural succession that pines were dominant, overall forests were more occupied by coniferous trees. However, coniferous trees have been gradually replaced by several broadleaf species such as *Quercus acutissima*, *Quercus mongolica* and *Quercus serrata*. The structure of age class of forests is leaning too much between 30 and 50 years of age.

Through time, major threats to biological diversity have shifted from the excessive use of forest resources or the exploitation of forest lands to increased demand for forest genetic resources, environmental issues such as climate change and environmental pollution and natural disasters such as forest fires and floods. In response, the national plan for forest biological diversity was established in 2007 to manage the threats to biological diversity, strengthen on-site and off-site conservation and restoration and promote the sustainable use of forest resources. According to this plan, as one of activities to cope with the problem of climate change, the native and special plants, particularly the forest genetic resources of alpine and sub-alpine zones, which are vulnerable to climate change, are monitored, and on-site and off-site efforts are undergoing to conserve such forest resources.

Given the importance of establishing a legal and institutional framework to conserve forest biological diversity, Korea has made progress within the framework of SFM to incorporate a wide range of activities for forest biodiversity conservation and promotion of sustainable forest utilization into the Forest Protection Act and the 5th National Forest Plan.

The Korean Government has designated diverse forms of forest protection areas such as the Baekdudaegan Reserves, the forest genetic resources reserves, the natural parks, the ecosystem and landscape conservation reserves, the wetland reserves and the natural monuments by KFS, the Ministry of the Environment (MoE), and the Cultural Heritage Administration, accounting for approximately above 10% of the total forest area in

Korea. These protected areas somewhat overlap due to the different scopes of managing organizations, protected entities and scale of protection, and it is therefore undeniable that the problems of consistency in managing protected areas somewhat exist. Nonetheless, the steady increase and management effectiveness evaluation of protected areas seem to be positively contributing to the preservation and maintenance of biological diversity.

The designation of the Baekdudaegan Reserves, which takes up the largest terrestrial area in Korea, and the efforts to expand designated protected areas overall increased the connectivity of conservation areas. It is however inevitable to find most of the reserved areas in the mountainous regions because most of the flat lands are used for housing or agricultural purposes due to the narrow form of the Korean geographical feature.

The Baekdudaegan Mountains run through almost the entire length of the Korean Peninsula. They serve as the nest of forest biological diversity and are also rich in cultural heritage. Protecting the integrity of the Baekdudaegan Mountains ensures the protection of forest lands from indiscreet development and preserves the topography and natural features of the mountain ranges. It also enables to restore the existing degraded forests and prevent the decline of forest biological diversity arising from habitats fragmentation by enhancing the connectivity of forest ecosystems through encouraging environment-friendly agricultural practices in the private lands within the protected reserves. Overall, the Baekdudaegan Reserves, designed to sustain and enhance an array of values and services of the forest ecosystem, is expected to be a lasting pillar of Korea's forest conservation efforts.

[Figure 1-1] Peak of Mountain Balwang, a part of the Baekdudaegan Reserves

Indicator 1-1 [MP 1.1.a] Area and percentage of forest by ecosystem type, successional stage, age class, and forest ownership

1) Definition and importance

Forests are known to be the biologically richest terrestrial ecosystem at the global level. Traditionally they have provided humans with diverse goods and services such as refuges, timber, pulp, firewood, food and medicines. So far only a fraction of the forest based species are known for potential uses to create medicinal, agricultural and industrial values.

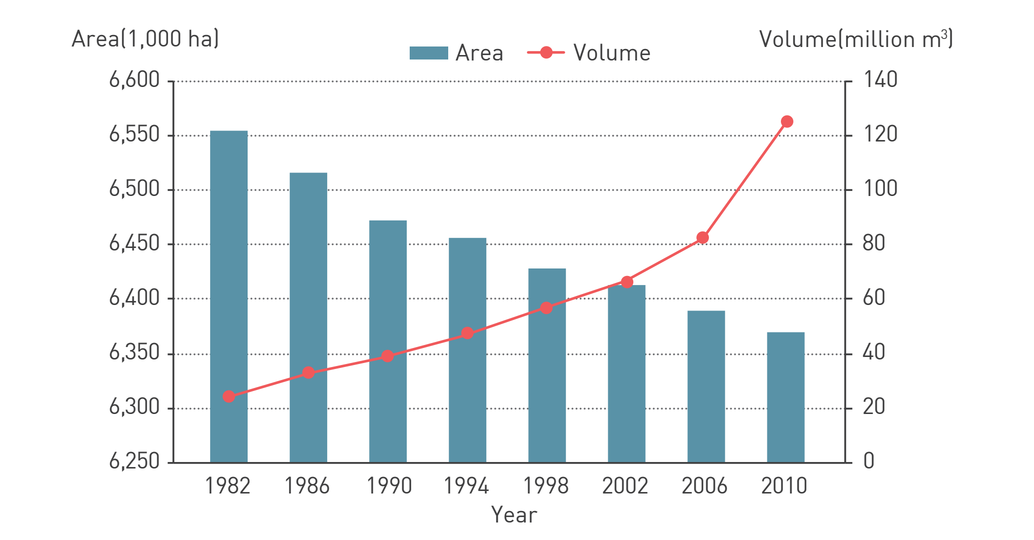
Forests are not only a collection of individual trees, but also serve to integrate the entire plant and wildlife communities into a single system by regulating light regime and improving soil and water traits essential for growth of living organisms. Roots prevent soil erosion, and foliage and fallen branches provide nutrients into soil, making a living environment for microorganisms. Tree stems including branches are important habitats for birds and arthropods, and crowns provide a growth base for epiphytes such as a mistletoe.

This indicator shows an overview of forest structure at the landscape level and biological diversity through forest types and their age class distribution. Successional processes of a forest ecosystem and maintenance of its population depend largely on the extent of ecological continuity or some core features engaged in structural and functional diversities of the ecosystem. Generally species are adapted to a certain successional stage. Although occupying much of the entire land area, most of the Korean forests are at an early or mid successional stage because they are a result of national forest rehabilitation projects after the Korean war era in the mid 1900s. Therefore, species inhabiting forests at a later successional stage are sometimes rare to find.

This indicator provides proportion of areas by forest types, enabling to explain forest dynamics and timber production, presence of certain wildlife or plant communities, presence of non-wood forest products and the aesthetic and recreational values of forests. As most species largely depend on a certain successional stage, this indicator also helps indirectly examine the status of biological diversity of forest ecosystems through monitoring the age class distribution and changes in areas by forest types.

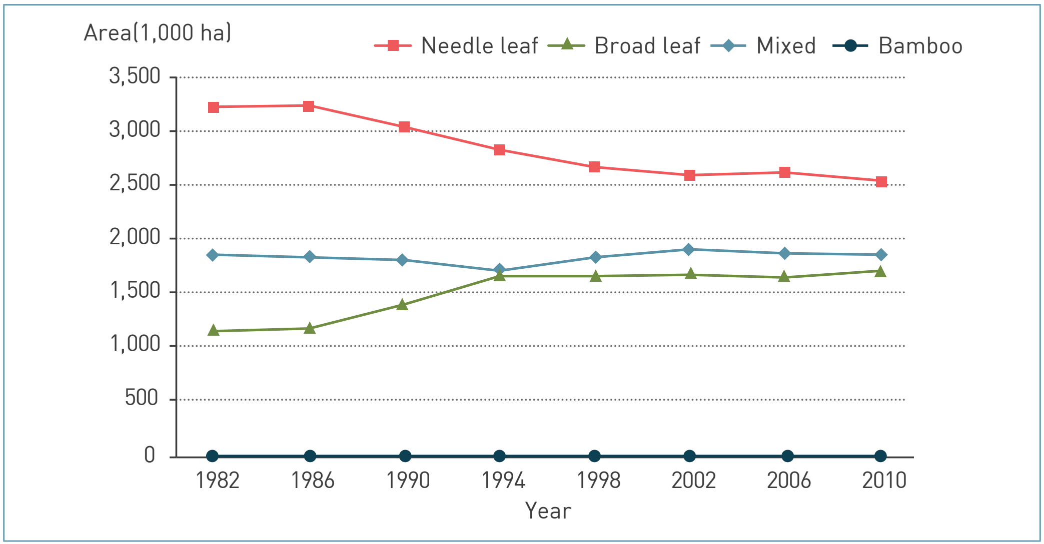
2) Data status and trend

The forest area increased from the late 1960s as a result of success of the national forest rehabilitation projects. However, there was a slight decrease in the forest area in the late 1970s due to the forest conversion by industrialization and urbanization. Up until the mid-1980s the forest conversion mainly occurred for agricultural and military purposes. Since then, this trend was changed to meet the demands for social infrastructure such as road buildings and factory and housing sites as well as leisure facilities such as golf courses. In the recent five years from 2009 to 2013 the forest conversion area was 10,188 hectares on an annual average. But the extent of forest conversion has fallen from 2010, resulting in 7,432 hectares in 2013. The ratios of forest conversion by purposes showed 18.0% for industrial sites, 15.0% for road constructions, 14.5% for housing sites, 8.2% for public uses and 5.9% for agricultural lands. The forest conversion by forest land use classification occurred in 2,293 hectares of conservation forests as 31% and in 5,139 hectares of semi-conservation forests as 69%. These figures, in comparison to those of 2012, was an increase by 13% in the conservation forests as 261 hectares and a decrease by 10% in the semi-conservation forests as 582 hectares. Overall percentage of conservation forests of the total conversion area increased by 5%. Since 1982 forest area has been on a steady decrease, but the extent of decrease slowed



[Figure 1-2] Changes in forest area and growing stock down after 2008, whereas the forest growing stock has steadily increased to 125 m^3 per ha on an average in 2010.

The changes in the forest area by forest type showed that, even though conifer forests are occupying the largest portion, they have significantly decreased from the late 1980s, whereas broadleaf and mixed forests have increased. The forest areas by forest type in 2010 showed 2,581 thousand hectares of conifer forests as 40.5%, 1,719 thousand hectares of broadleaf forests as 27.0% and 1,865 thousand hectares of mixed forests as 29.4%. Comparing to 1990, conifer forests decreased by about 498 thousand hectares, whereas broadleaf and mixed forests increased by 330 thousand hectares and 55 thousand hectares, respectively.



[Figure 1-3] **Changes of forest areas by forest type**

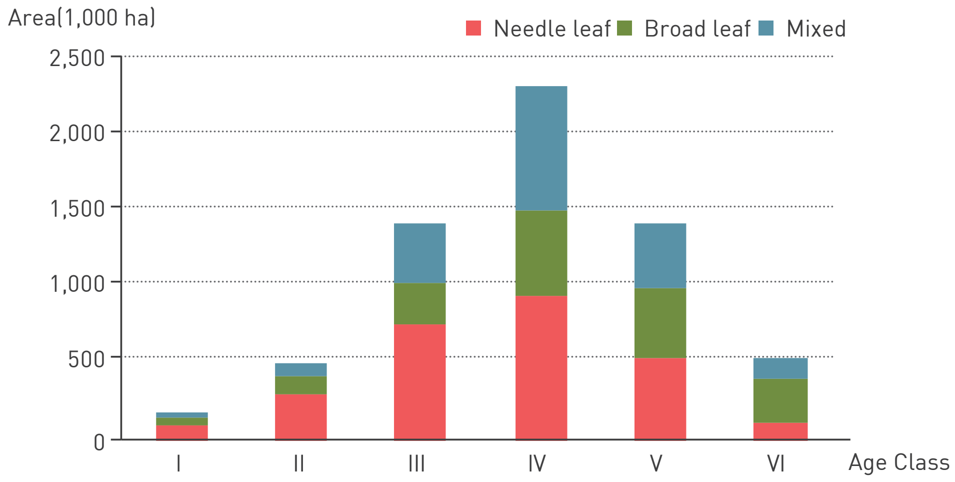
These trends in changes of forest areas are closely related to Korea's recent history and successional stages. First of all, in terms of Korea's recent history, following a state of extreme devastation during and after the colonial period and the Korean war, pines dominated as a settled species in the early secondary succession stage. In addition, major tree species planted during the first and second national reforestation projects started both in 1973 and 1979 were conifer trees including *Pinus densiflora*, *Pinus rigida*, *Larix kaempferi*, *Pinus korainesis*, *Chamaecyparis obtusa*, and *Cryptomeria japonica*. Therefore, conifer trees dominated Korean forests since the 1980s. However, proportion of conifer forests has been gradually reduced by native broadleaf forests such as oaks as a result of natural succession in unsuccessful plantations, large-scale invasions by *Dendrolimus spectabilis* (Pine caterpillar), *Thecodiplosis japonensis* (Pine needle gall midge) and *Matsucoccus thunbergianae* (Black pine bast scale) and forest fires. In terms of forest succession, decrease in conifer forests, mainly dominated by pines, seems to be a very natural phenomenon. When most of the forest land is very desolate, the young trees require lots of light and species which grow better in dry and barren soil achieves a community first over other species. For instance, many of pine forests were formed through this process. The decrease of pine forests is a natural process toward the secondary successional stage. The initial formation of a pine forest improves soil conditions by organic composition and water retention of soil. And then shade tolerant oak trees overtake pine trees because oaks lay roots and grow faster in the earlier stage than pines under dimmer circumstances. Moreover, a high degree of crown closure and a low level of soil exposure make a natural regeneration of pine trees difficult, resulting in overall decrease of pine population. Therefore, in order to maintain pine forests which hold economic, social and cultural values, silvicultural treatments more suitable for them are required.

The forest area by ownership in 2010 showed that national forests occupied approximately 1,543 thousand hectares accounting for 24.4% of the total forest area, whereas public and private forests occupied 488 thousand hectares as 7.7% and 4,338 thousand hectares as 68.1%, respectively. Compared to 1995, national forests increased by about 11%, that was 151 thousand hectares, while public and private forests decreased by 5% and 1%, respectively. Such area changes are the result of national efforts to purchase private forests with respect to the expansion of protected areas.

[Table 1-1] **Changes of forest area by ownership**

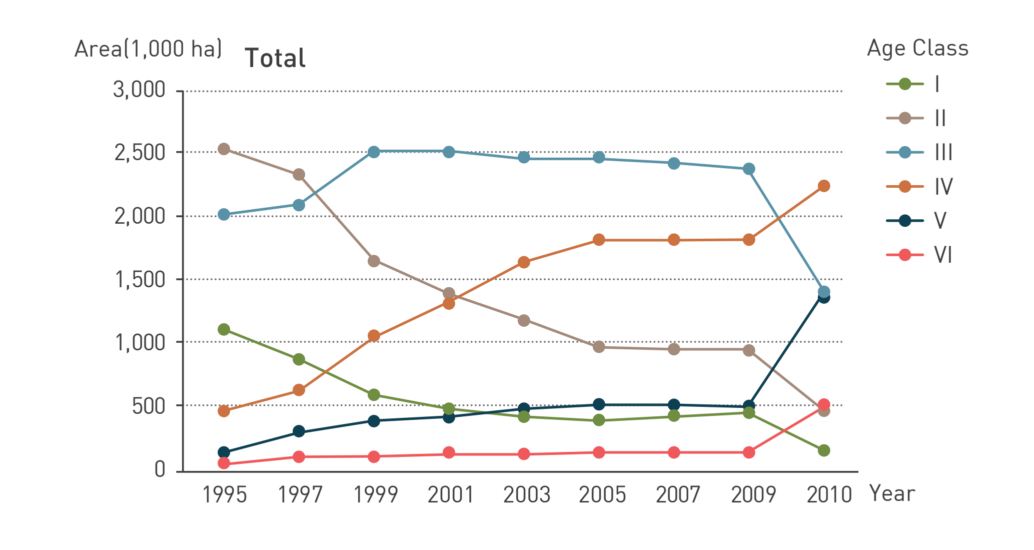
Year	National	Public	Private
1995	1393	492	4567
2000	1433	493	4496
2005	1484	489	4420
2010	1543	488	4338

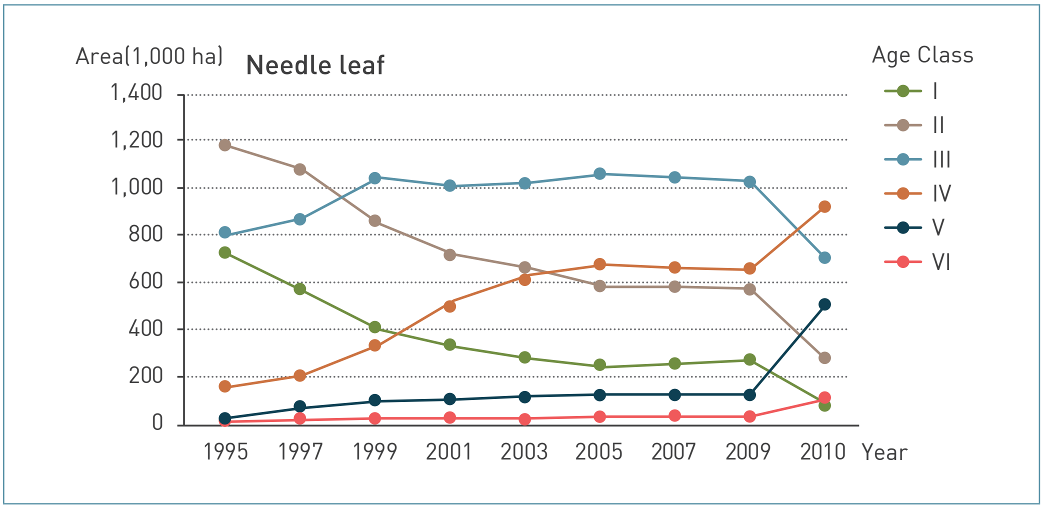
The distribution of forests by age class seems to be a bell shaped structure with age class IV occupying the highest coverage. The majority of forests in age class III and IV are plantations established during the first and second national reforestation projects during 1973 to 1987. These plantations are largely composed of conifer species, such as *Pinus densiflora*, *Pinus rigida*, *Larix kaempferi*, *Pinus koraiensis*, *Chamaecyparis obtusa*, and *Cryptomeria japonica*.



[Figure 1-4] Forest areas by forest type and age class

The forest areas by age class from 1995 to 2010 showed that age class III and IV occupied most of the total forest area. Age class II declined whereas age class V and VI showed a slight increase. Conifer forests have been decreasing overall, and, as forests matured, age class II decreased by 2,047 thousand hectares and age class IV increased by 1,793 thousand hectares due to the ingrowth of age class II and III, compared to 1995. Since 2009 age class III decreased the most and age class V increased the most. Age class I, II and III showed a sharp decrease while age class IV, V and VI a sharp increase. This trend appears the same across all broadleaf forests, conifer forests and mixed forests. In case of broadleaf forests, age class I was on a steady increase, but since 2009 it declined sharply. It seems that, once thrived under the effects of natural regeneration of damaged areas from forest fires and pest infestations as well as species replacement of rigida pines, but the recent forest tending for secondary natural broadleaf forests, centered around young trees, caused declining of age class I. In cases of both conifer and mixed forests, age class II and III showed a sharp decline. This also appears to be the result of forest tending and removals of pines infested with pine wilt disease and damaged trees by forest fires.





[Figure 1-5] Changes of forest areas by forest type and age class

Indicator 1-2 [MP 1.1.b] Area and percentage of protected forests by ecosystem type, age class or successional stage

1) Definition and importance

The COP10 of Convention on Biological Diversity (CBD) in 2010 in Nagoya adopted a strategic plan to expand global terrestrial protected areas to capture 17% of the world total terrestrial area by 2020. In addition, UNEP's World Conservation Monitoring Centre has been establishing the largest global protected area database in the world in a consortium with IUCN World Commission on Protected Areas (IUCN-WCPA) and the World Database on Protected Areas (WDPA). Such efforts imply that how important it is to expand the coverage of protected areas as well as to assure the continuity of natural areas including forests for maintaining and promoting biological diversity. In order to implement the CBD Programme of Work on Protected Areas (PoWPA), Korea has made efforts to increase efficiency in managing protected areas through expanding protected areas, evaluating management effectiveness and promoting cooperation among the managing bodies for protected areas.

The area and percentage of protected forest ecosystems indicate the level of willingness to designate and manage representative ecosystems as protected areas for conservation of biodiversity. Maintaining information on the representative forest types within protected areas can be helpful for achieving SFM. Traditionally, protected areas have been set aside for conservation of ecosystems and protection of landscape and recreation values. Even if a certain protected area of ecosystem may not represent the full range of biological diversity, such designation of a protected area can be a part of national conservation strategy to conserve rare and endangered species, and enables protection of biodiversity at a certain degree. As forest types and their associated flora and fauna within protected areas are expected to change over time, a long-term monitoring of such changes will be necessary as a part of strategies for conserving biodiversity. Conservation of ecosystems and biological diversities in protected areas ultimately enables to achieve SFM in pursuit of diverse functions of forests including wood production.

2) Data status and trend

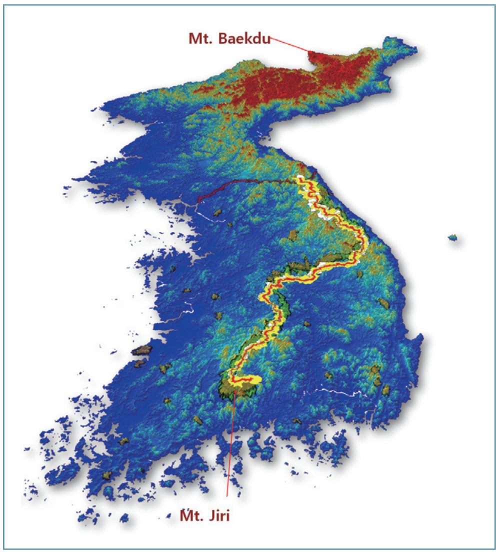
Korea holds a small terrestrial area per capita and a high level of developmental pressure on forests, which take up the largest proportion of the terrestrial ecosystem. Therefore KFS has implemented policies to promote the values of forest resources and the functions of forest culture and recreation, and to raise the income of rural mountain villages and local communities, and also ensured a legal framework to protect forests such as the forest genetic resources reserves and the conservation forests as well as the Baekdudaegan Reserves in the pursuits of balanced conservation and use of forests and maintenance of forest biological diversity. In particular, KFS designates and manages the forest genetic resources reserves in such areas of virgin forests over 1 ha, alpine zones, unique forest types, rare plant habitats and useful plant habitats, worthwhile to protect for genetic and ecological conservation and academic studies. The total area of the Baekdudaegan Reserves and the forest genetic resources reserves increases each year through purchasing nearby private forests and restoring the land registration above the CCL. The total area of the Baekdudaegan Reserves is at 2,740 km^2 as of 2014, and that of the forest genetic resources reserves at 1,494 km^2 as of 2013.

The Ministry of Environment has designated and managed areas which are worth of protecting the ecological values and rich biodiversity. As of 2014, there are seven mountainous ecosystem and landscape reserve sites with a total area of 241.2 km^2. As well, among all the 78 natural parks including all national parks and local government's designated parks, 56 parks are located in the mountainous areas occupying 928 km^2, and there are 11 mountain wetlands reserves with an area of 5.77 km^2 among the 18 wetland reserves designated for conservation and management of wetlands.

In terms of protected lands of international importance, the 55 forest genetic resources reserves including the Baekdudaegan Reserves have been enlisted in the WDPA as of 2013, and mountain wetlands such as Yongneup of Mt. Daeamsan with 1.1 km^2 were designated as the Ramsar wetlands by the Ramsar Convention. Four sites were designated as the UNESCO Bioshpere Reserves such as Mt. Seoraksan of 3,932 km^2, Jeju Island including Mt. Hallasan of 831 km^2, terrestrial area of 145 km^2 in Sinan-gun's archipelago of Jeonnam province and Gwangneung Forest of 221 km^2.

(1) Baekdudaegan Reserves

To conserve and manage the Baekdudaegan Mountains, which form the backbone of the terrestrial ecosystem, including associated maintain ranges, the Baekdudaegan Mountains Protection Act was enacted in 2003. The government made efforts to reach public consensus in the process of enacting the law and establishing the protected areas. As a result, 260,000 hectares of forest lands were designated as Baekdudaegan Reserves, 170,000 hectares of the core areas and 90,000 hectares of buffer zones, in September 2005. It is the single largest protected area of terrestrial ecosystems in Korea, occupying 2.6% of the total land base and 4% of the total forest area.

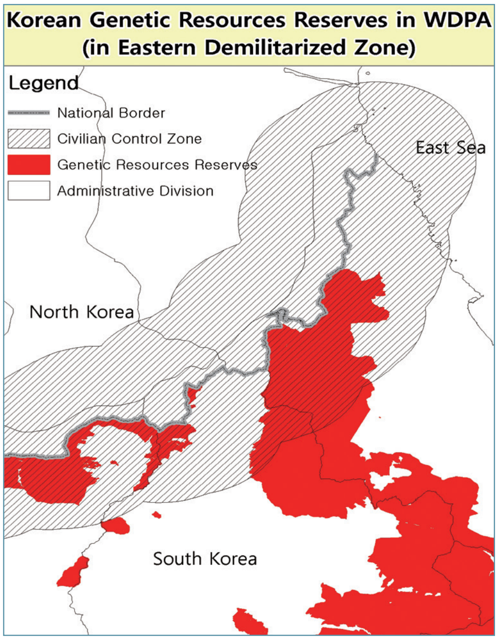


[Figure 1-6] Topography of Korea and the Baekdudaegan Reserves

The Baekdudaegan Mountains as a main range is a source of forest biodiversity and holds abundant cultural assets. Protecting the integrity of the Baekdudaegan Mountains ensures the protection of forest lands from indiscreet development, preserves the topography and natural features of the mountain range and enables effective restoration of the existing degraded areas. It also helps preventing the degradation of forest biological diversities arising from fragmentation of habitats by enhancing the connectivity of forest ecosystems through encouraging private land owners within the boundary of the protected areas to practice environmentally sound agricultural treatments. The Baekdudaegan Reserves will play a symbolic role of the protected areas designated for sustaining and promoting the health of forest ecosystems which provide an array of values and services.

In addition to the previously designated area of 263,000 hectares of the Baekdudaegan Reserves, KFS additionally designated 11,000 hectares to this reserves by purchasing adjacent private forests and restoring the land registration in the north of the CCL as the national forests according to the Baekdudaegan Mountains Protection Plan. Especially due to the newly designated 9,000 hectares in the north of the CCL, the past northern end of Baekdudaegan Mountains' Marugeum, Hyangrobong of Mt. Seoraksan, now extends to the Demilitarized Zone (DMZ) area, thus making the total length of Marugeum from 684 km to 701 km. As well, many restoration projects and related researches in the degraded lands are undergoing in order to restore the structure and functions of the forest ecosystems. Such efforts to expand the Baekdudaegan Reserves will not only prevent further degradation of forest ecosystems but also contribute to the promotion of biodiversity at the national level by ensuring a biological continuity.

[Figure 1-7] Pilot project to restore cut slopes of forest roads in the Baekdudaegan Reserves

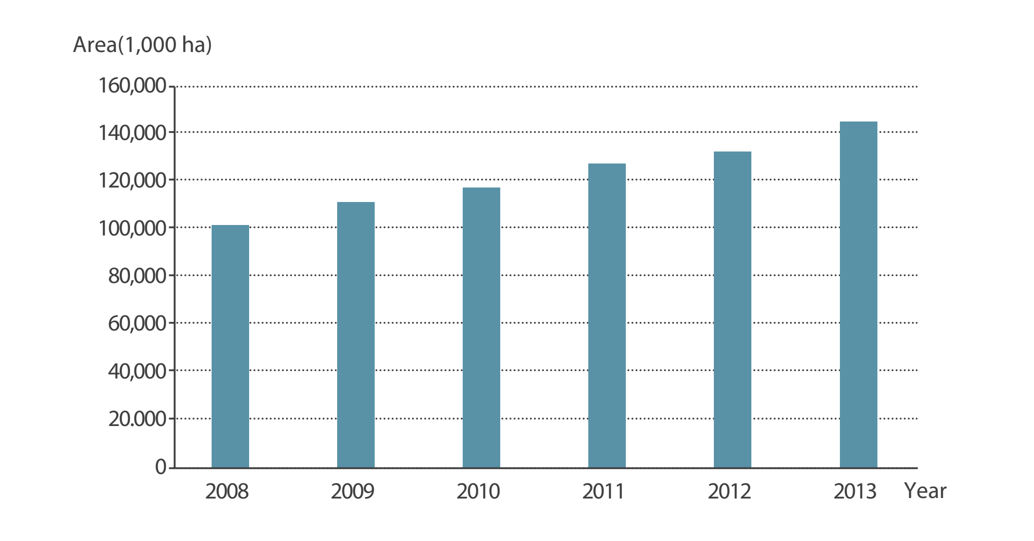


[Figure 1-8] Expansion of Baekdudaegan Reserves, north of CCL

(2) Forest genetic resources reserves

Forest genetic resources reserves are designated in the forests needed for a special care to protect plant genes, species diversity or forest ecosystems such as old growth forests, alpine flora zones, habitats of rare species or useful plants, forest wetlands and valley streams in forests.

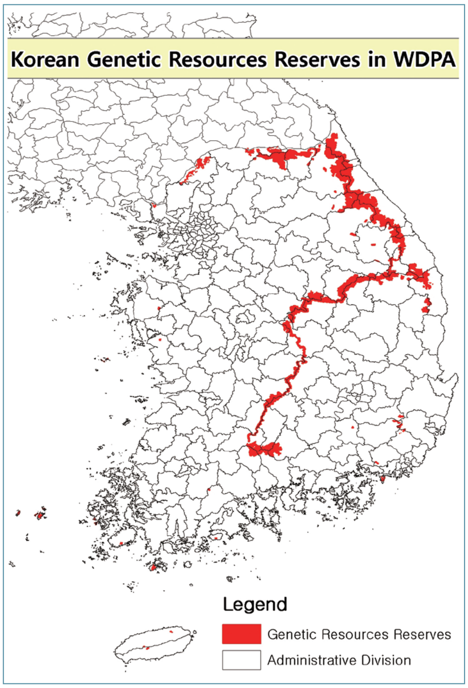
As the importance of conserving biological diversity and protecting forest ecosystems became more apparent, the designated areas of forest genetic resources reserves steadily increased from 207 sites of 22,106 hectares in 2003 to 251 sites of 90,254 hectares in 2007, and to 599 sites of 149,432 hectares in 2013. This indicates that expansion of forest genetic resources reserves gives effects not only on conserving rare habitats and genetic resources but also on improving ecosystem diversities. To meet these ends, KFS have planted native



[Figure 1-9] Status of designation for the Forest Genetic Resources Reserves

or local species to rehabilitate waste or damaged lands and to form succession forests. Also, dead, damaged and infested trees were thinned out as needed to promote landscape and health of forests and biodiversity and to protect the preserved species and lower vegetation. KFS is continuously performing conservation projects for biological diversity in the superior forests by establishing various signs, fences and ecological observation paths to prevent from human damages.

KFS actively participates in the worldwide environmental evaluations such as the Environmental Performance Index and continues to enroll additional forest genetic resources reserves into the WDPA in order to implement CBD-PoWPA. As of 2013, there are 55 forest genetic resources reserves registered on WDPA occupying 369,539 hectares.



[Figure 1-10] Integrated Database of the Forest Genetic Resources Reserves

[Table 1-2] Status of the Forest Genetic Resources Reserves registered on WDPA

Designation	Name	Location	Area(ha)	Main Feature
Total		55 sites	369,539	
1st registration (Apr. 2010)	Sub-total	6 sites	301,115	
	Baekdudaegan	Ilwon	263,400	*Pinus densiflora, Quercus mongolica*
	Sogwangri	Seohawon, Ulgin	8,208	*Pinus densiflora, Quercus variabilis, Rhododendron micranthum*
	Ulleungdo	Seotaeha, Ulleng	1,647	*Acer pictum*
	Eungbongsan	Gagok, Samchuk	7,611	*Rhododendron micranthum*
	Jumbongsan	Jundong, Girin, Inje	2,938	*Quercus mongolica, Betula costata*
	Hyangrobong	Junbu, Gansung, Gosung	17,311	*Syzygium aromaticum, Rhododendron brachycarpum, Hanabusaya asiatica*
2nd registration (Jun. 2012)	Sub-total	10 sites	43,324	
	Gariwangsan	Sookam, Bukpyung, Jeongseon	2,475	*Loranthus tanakae, Thuja koraiensis*
	Geommasan	Suha, Subi, Yeongyang	3,467	*Iris odaesanens*
	Gyebangsan	Jawoon, Hongcheon	5,866	*Pinus densiflora, Hanabusaya asiatica*
	Dongbaekdongsan	Seonhong, Jocheon, Jeju	139	*Quercus gilva, Daphne kiusiana*
	Baekseoksan	Songhyeon, Bangsan, Yanggu	10,993	*Tilia mandshurica, Fraxinus mandshurica, Hanabusaya asiatica*
	Baegamsan	Deungdae, Wondong, Cheolwon	8,618	*Quercus mongolica, Betula davurica*
	Sumeunmulbaengdui	Gwangryeong, Aewol, Jeju	72	*Allium taquetii, Ligularia fischeri, Juncus effusus*
	Jeokgeunsan	Jinhyeon, Wonnam, Cheolwon	1,849	*Quercus mongolica, Carpinus laxiflora*
	Cheongoksan	Wonsi, Seokpo, Bonghwa	4,744	*Betula davurica, Asperula lasiantha*
	Punch Bowl	Oyu, Haean Yangg	5,101	*Echinochloa frumentacea, Fraxinus mandshurica, Hanabusaya asiatica*
3rd registration (Nov. 2013)	Sub-total	39 sites	25,100	
	Gadeokdo	Daehang, Gangseo, Busan-si	568	*Pinus thunbergii, Pinus densiflora, Asarum maculatum*
	Garisan	Inje, Gangwon-do	278	*Pinus densiflora*
	Gajisan	Milyang, Sannae, Gyeonsangnam-do	513	*Primula modesta, Aristolochia manshuriensis, Asarum maculatum*
	Geogeumdo	Geumsan, Goheung, Jeollanam-do	148	*Utricularia bifida, Thalictrum uchiyamai*
	Gyeungsan	Gimhwa, Cheolwon, Gangwon-do	226	*Miscanthus sacchariflorus, Phragmites japonica*
	Dalsanryeong	Seohwa, Inje, Gangwon-do	894	*Salix koriyanagi Kimura, Philadelphus schrenckii*
	Daeseongsan	Sangseo, Hwacheon, Gangwon-do	352	*Quercus mongolica, Pinus densiflora, Philadelphus schrenckii*

	Daeyado	Haui, Sinan, Jeollanam-do	168	*Pinus thunbergii, Woodwardia japonica, Milletia japonica*
	Deoguri	Deogu, Jeongseon, Gangwon-do	257	*Caragana fruticosa, Prunus choreiana*
	Duwibong	Sabuk, Jeongseon, Gangwon-do	175	*Taxus cuspidata*
	Munsusan	Chunyang, Bonghwa, Gyeonggi-do	671	*Viola diamantiaca, Asperula lasiantha*
	Minbuk (Yeoncheon)	Baekhak, Yeoncheon, Gangwon-do	1,652	*Quercus acutissima, Quercus serrata*
	Balwangsan	Suha, Daegwanryeong, Pyeongchang	221	*Taxus cuspidata, Abies nephrolepis*
	Bangtaesan	Girin, Inje, Gangwon-do	164	*Hanabusaya asiatica, Rodgersia podophylla*
	Bogugotri	Wolgot, Kimpo, Gyeongi-do	129	*Quercus variabilis, Quercus mongolica*
	Bogildo	Bogil, Wando, Jeollanam-do	478	*Quercus acuta, Castanopsis sieboldii*
	Bulmosan	Jangyu, Gimhae, Gyeonsangnam-do	288	*Cayratia japonica, Acer pictum* subsp. *mono*
	Bisugumi	Hwacheon, Gangwon-do	3,711	*Cypripedium japonicum, Eleutherococcus divaricatus* var. *chiisanensis*
	Sangbatjae	Hongcheon, Gangwon-do	258	*Quercus mongolica, Pinus densiflora*
3rd registration (Nov. 2013)	Seoraksan Daeseungryung	Inje, Gangwon-do	1,061	*Hanabusaya asiatica and other* 38 species
	Sindo	Haui, Sinan, Jeollanam-do	135	*Pinus thunbergii, Machilus thunbergii, Daphne kiusiana*
	Sinbulsan	Wondong, Yangsan, Gyeonsangnam-do	339	*Primula modesta, Habenaria iyoensis, Sanguisorba hakusanensis*
	Yeokwisan	Imhoe, Jindo, Jeollanam-do	165	*Camellia japonica, Castanopsis sieboldii*
	Yongsil	Hawon, Seogwipo, Jeju	179	*Pinus densiflora* (90 years)
	Okgye	Cheongla, Boryeong, Chungcheongnam-do	161	*Pinus densiflora, Quercus variabilis, Platycarya strobilacea*
	Oeyeon	Ocheon, Boryeong, Chungcheongnam-do	156	*Lilium tsingtauense, Ajuga spectabilis, Lilium amabile*
	Yongneup	Seohwa, Inje, Gangwon-do	278	*Trientalis europaea, Drosera rotundifolia*
	Yonghyeon	Wunsan, Seosan, Chungcheongnam-do	273	*Quercus variabilis, Platycarya strobilacea, Hovenia dulcis*
	Unmun	Unmun, Cheongdo, Gyeongbuk-do	538	*Quercus mongolica, Stewartia pseudocamellia*
	Eulsugol	Hongcheon, Gangwon-do	3,451	*Quercus mongolica, Fraxinus rhynchophylla*
	Eunggol	Inje, Gangwon-do	557	*Quercus mongolica, Quercus variabilis*
	Jangjaebong	Boknae, Boseong, Jeollanam-do	192	*Lycoris koreana, Indigofera pseudotinctoria*

3rd registration (Nov. 2013)	Juparyeong	Sangseo, Hwacheon, Gangwon-do	1,989	*Pinus densiflora, Quercus mongolica*
	Cheonbulsan	Gimhwa, Cheolwon, Gangwon-do	887	*Quercus mongolica*
	Cheonhwangsan	Sangbuk, Ulju, Ulsan	814	*Primula modesta, Viola albida Palibin*
	Hanmukryeong	Hwacheon, Gangwon-do	1,420	*Quercus mongolica, Rodgersia podophylla*
	Hongdo	Heuksan, Sinan, Jeollanam-do	387	*Pinus thunbergii, Machilus thunbergii*
	Hwawangsan	Changnyeong, Gyeonsangnam-do	128	*Quercus mongolica, Sapium japonicum*
	Heuksando	Heuksan, Sinan, Jeollanam-do	839	*Pinus thunbergii, Machilus thunbergii*

(3) Ecosystem and landscape conservation reserves

The areas that hold either a high ecological value or wildlife habitats needed for special care or excellent landscape have been designated as the ecosystem and landscape reserves. As of 2014, the Ministry of Environment, the Ministry of Maritime Affairs and Fisheries and local governments have designated the 36 ecosystem and landscape conservation reserves, 7 sites of which are located in mountains including Mt. Jirisan, occupying 241.2 km^2.

[Table 1-3] Mountainous ecosystem and landscape conservation reserves

Name	Location	Area (km^2)	Main Feature	Date of Designation
Mt. Jirisan	Simwongyegok Sandong-myeon and Piagol Toji-myeon Gurye-gun, Jeollanam-do	20.20	Climax forest (*Abies koreana*, etc.)	1989. 12.29
Seomjingang River Otter Habitat	Muncheok-myeon, Ganjeon-myeon and Toji-myeon, Gurye-gun, Jeollanam-do	1.834	Habitats for endangered species (otter)	2001. 12.01
Gosanbong copper-winged bat habitat	Daedong-myeon Hanpyeong-gun, Jeollanam-do	8.78	Habitats for endangered species (copper-winged bat)	2002. 05.01
Donggang River	Yeongwol-up Yeongwol-gun, Jeongseon-eup and Sindong-eup Jeongseo n-gun, and Mitan-myeon Pyeongchang-gun, Kangwon-do	72.845	Landscape and geographical value, Habitats for rare flora and fauna	2002. 08.09
Wangpicheon Stream Watershed	Seo-myeon and Geunnam-myeon Uljin-gun, Geongsangbuk-do	102.841	Landscape and geographical value, Habitats for rare flora and fauna	2005. 10.14
Mt. Unmunsan	Unmun-myeon Cheongdo-gun, Geongsangbuk-do	26.394	Landscape and Habitats for endangered species such as otter, flying squirrel, marten & *Paeonia obovata*	2010. 09.09
Geogeumdo, Jeokdaebong	Jeokdaebong Geogeumdo, Goheung-gun, Jeollanam-do	8.365	Habitats for endangered species and unique flora & fauna	2011. 01.07

(4) Natural parks

Natural parks includes national parks as well as provincial and county parks. Since the first Mt. Jirisan national park in 1967, a total of 21 terrestrial and marine parks were designated as national parks. As of 2013 the areas of national parks cover approximately 6,656 km^2, of which 3,902.5 km^2 is in terrestrial areas, and 17 national parks are located in mountainous regions, occupying 59% of the total area.

The Mt. Jirisan national park covers the largest area among all of the mountainous national parks as 483 km^2, amounting to 14.1% of the mountainous national parks. The next one is Mt. Seoraksan with the area of 398 km^2, and then followed by Mt. Odaesan of 326 km^2 and Mt. Sobaeksan of 322 km^2.

(5) Forest wetlands reserves

As of 2014 the Ministry of Environment has designated 18 wetlands conservation areas, occupying 177.2 km^2 in total, 11 of which are mountainous wetlands occupying 5.77 km^2 and include Yongneup of Mt. Daeamsan. 8 sites of the 11 wetlands have been registered as the Ramsar wetlands.

[Table 1-4] **Mountainous wetlands conservation areas**

Name	Location	Area (km²)	Main Feature	Date of Designation
Yongneup of Mt. Daeamsan	Seowha-myeon, Inje-gun, Gangwon-do	1.06	The only high altitude wetlands in Korea, inhabiting rare flora and fauna	1999. 8. 9. (1997. 3. 28.)
Mujechineup	Joilri, Samdong-myeon, Ulju-gun, Ulsan	0.18	Forest wetlands with rare wildlife and plants	1999.08.09 (1997.12.20)
Mulyeongari Oreum	Namwon-up, Namjeju-gun, Jeju-do	0.31	Parasitic volcano wetlands	2000.12.05 (2006.10.18)
Whaeum-neup	Yongyeonri, Habuk-myeon, Yangsan-si, Gyeonsangnam-do	0.12	Forest wetlands with peat layers	2002.02.01
Mt. Sinbulsan Highland Wetland	Daeri, Wondong-myeon, Yangsan-si, Gyeonsangnam-do	0.31	Habitats for rare species such as hedgehogs and *Drosera rotundifolia*	2004.02.20
Sinanjangdo Wetland	Jangdo (Is.), Biri, Heuksan-myeon, Sinan-gun, Jeollanam-do	0.09	Habitats for endangered species and well-conserved peat layers	2004.08.31 (2005.03.30)
Milyang Jaeyaksan Sajapyeong High Forest Wetland	Gucheonri, Danjang-myeon, Milyang-si, Gyeonsangnam-do	0.58	Habitats for endangered species and well-conserved peat layers	2006.12.28
Jeju 1100 Highland Wetland	Saekdal-dong & Jungmun-dong, Seoguipo-si ~ Gwangryeongri, Aewol-eup, Jeju-si	0.126	Habitats for endangered and rare species and developed in a rare geography	2009. 10. 1. (2009. 10. 12.)
Jeju Muljangori Oreum Wetland	Bonggae-dong, Jeju-si, Jeju-do	0.610	Habitats for endangered species and well-conserved peat layers	2009. 10. 1. (2008. 10. 13.)
Jeju Dongbaekdongsan Wetland	Seonholri, Jocheon-eup, Jeju-si, Jeju-do	0.590	High level of biodiversity and underground water in Gotjawal	2010. 11. 12. (2011. 3. 14.)
Gochang Ungok Wetland	Ungokri, Asan-myeon,, Gochang-gun, Jeollabuk-do	1.797	High biodiversity and habitats of at-risk species, otter	2011. 3. 14. (2011. 4. 7.)

※ ( ) : the Ramsar registered date

Indicator 1-3 [MP 1.2.a] Number of forest associated species

1) Definition and importance

This indicator provides information on the health of a forest ecosystem through the changes in the number of forest associate species in natural forests. Monitoring of the number of forest associate species in natural forests helps understand interrelationships among species within an ecosystem and forest conservation reserves. Either extinct or newly introduced species serve as an indicator being able to judge the extent of the health and productivity of a forest ecosystem.

2) Data status and trend

The Korean forests and forest ecosystems are mainly centered around the ranges of Baekdudaegan where a diverse vegetation zones are distributed from subtropical to boreal zones. Korea has a diverse and abundant forest resources among the temperate climate countries even though the total land base is small.

Forests occupy 64% of the entire territory. In the northern areas, subalpine conifer forests are well developed. In some parts of the northern and central areas, mixed forests occupy large areas. Deciduous broadleaf forests, representing natural forests, dominate in the central region. Evergreen broadleaf forests mainly occupy in the southern areas and east and west coastlines. *Carpinus laxiflora* forests are well grown in valleys of mountain slopes formed with granite or granite gneiss, and warm temperate evergreens in the southernmost coastlines and islands.

The number of species as an indicator of biodiversity can be found in the Convention on Biological Diversity-Clearing House Mechanism (CBD-CHM) KOREA. The Korean peninsula due to its diverse topography and climate encompasses a very diverse living organisms, and there are many special species that are unique. Even though approximately 100,000 species are estimated to inhabit the Korean peninsula, only 40,000 species have been identified so far.

The species in the Korean forest ecosystem have been reported 4,496 species of higher plants, 4,175 species of native plants and 321 species of naturalized plants. There are also 125 species of mammals, 519 species of birds, 14,297 species of insects, 3,413 species of fungi and 691 species of lichen.

The establishment of the species list has been done through the national natural environment survey conducted since 1997. KFS has also been carrying out surveys on forest species and vegetation distribution through the Korea Forest Research Institute (KFRI) and the Korea National Arboretum (KNA).

Moreover, the ecosystem approach was introduced for conservation of forest biodiversity and the scientific management and monitoring system was established according to the 5th National Forest Plan (2008-2017). In particular, the first Forest Biodiversity Basic Plan has been set in 2008 and the 3rd plan is now being implemented from 2014. As well, according to the plan, the Korea Biodiversity Information System (http://www.nature.go.kr) was established to build a database based on the various surveys such as the Korean Peninsula Vascular Plant Survey conducted from 2003.

[Table 1-5] National forest-associated species inventory (as of 2012) & higher plants inventory (as of July 31, 2014)

Category	Species	Category	Species
Mammal	125	Flagella	634
Fish	1,190	Green Algae	1,292
Amphibian	21	Stonewort	33
Reptile	31	Marine Algae	861
Bird	519	Fungus	3,413
Invertebrate	6,468	Lichen	691
Insect	14,297	Protist	1,573
Vascular Plant	4,496	Bacteria	999
Bryophyte	924	Blue-Green Algae	237
Diatom	1,616	**Total**	**39,420**

※Source : CBD-CHM Korea (http://www.cbd-chm.go.kr)
Korea Biodiversity Information System (http://www.nature.go.kr/)

Indicator 1-4
[MP 1.2.b]

Number of forest associated species at risk as determined by legislation or scientific assessment

1) Definition and importance

This indicator informs on the number and status of forest-associated species at risk of extinction or in serious decline of population. In order to preserve species at risk, it requires special measures or human intervention. Tracking the number of at risk species and its status indicates the health of forest ecosystems and to what extent biodiversity can be maintained.

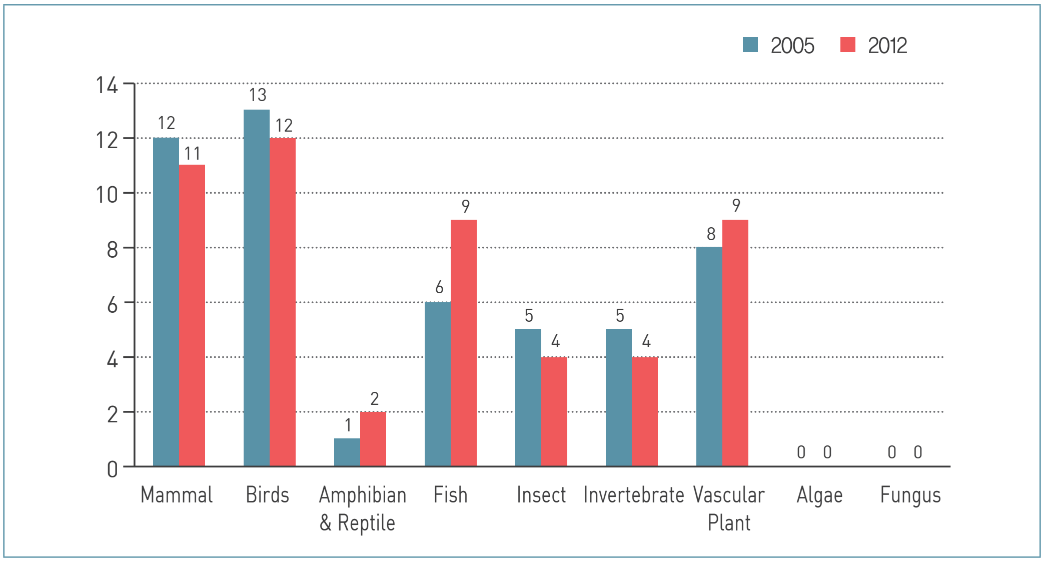
2) Data status and trend

KFS designated rare plants represent the forest plants at risk, and historically Park Man-Gyu classified 106 categories as rare plants in 1975, Lee Young-Noh 118 categories in 1981, Lee Chang-Bok 79 categories in 1987 and Hyun Jin-Oh 174 categories in 2001.

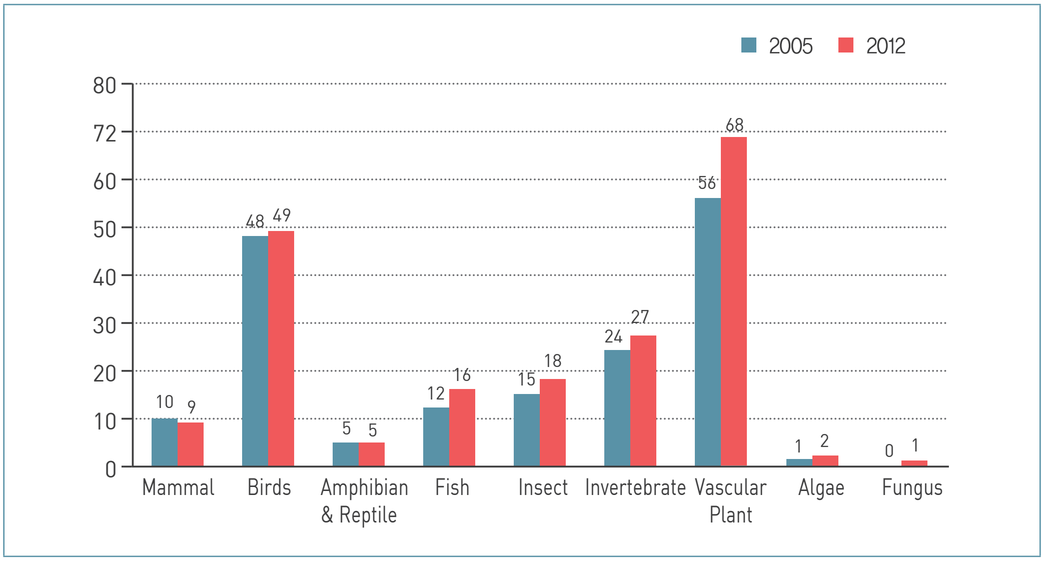
The at risk of extinction wildlife report by the Ministry of Environment in 2012 presents 246 species at risk of extinction at the national level, of which there are 51 species of Extinction Risk Class I and 195 species of Extinction Risk Class II. Terrestrial plants of 77 species took up the highest proportion of all at risk species, followed by birds of 61 species and invertebrates of 31 species.

[Table 1-6] Wildlife species at risk of extinction

Classification	Total	Mammal	Birds	Amphibian	Reptile	Fish	Insect	Invertebrate	Land animal	Marine Algae	Bacteria
Total	246	20	61	3	4	25	22	31	77	2	1
Extinction Risk Class I	51	11	12	1	1	9	4	4	9	-	-
Extinction Risk Class II	195	9	49	2	3	16	18	27	68	2	1



[Figure 1-11] **Changes in the number of Extinction Risk Class I Species**



[Figure 1-12] **Changes in the number of Extinction Risk Class II Species**

The list of wildlife species at risk was updated from 221 species in 2005 to 246 species in 2012. The number of the Extinction Risk Class I species increased to 51 in 2012 from 50 in 2005 and that of the Extinction Risk Class II species to 195 in 2012 from 171 in 2005.

KFS listed 217 categories as rare plants and 41 candidate categories on the illustrated guidebook of the rare and near extinction plants in Korea published in 1998, and KNA published the rare plants catalogue in Korea in 2009 where it listed 571 categories as rare plants. The Arboretum Establishment and Promotion Act was also enacted in 2011 to lay a legislative foundation for the protection of rare plants.

The forest associated species that are either particularly vulnerable to climate change, forest disaster or human induced damage, or high in economic, cultural and academic values have been designated as special species for protection from 2012 according to the Forest Protection Act. These are 53 species in total, of which there are 44 species of plants and 9 species of mushrooms.

[Table 1-7] Rare Plants of Korea

Category \ Class	EW	CR	EN	VU	LC	DD	Total
Pteridophyte	2	20	15	16	5	12	70
Gymnospermae	-	2	1	4	3	1	11
Angiospermae	2	122	106	99	62	99	490
Dicotyledoneae	1	80	81	79	48	70	359
Monocotyledoneae	1	42	25	20	14	29	131
Total	4	144	122	119	70	112	571

* EW: Extinct in the Wild, CR: Critically Endangered, EN: Endangered
VU: Vulnerable, LC: Near Threatened, DD: Data Deficient

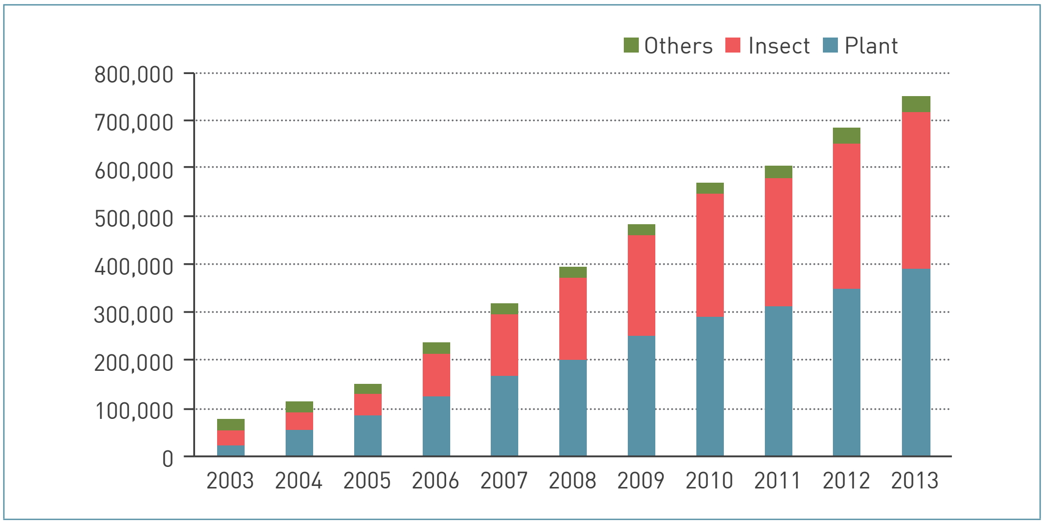
Indicator 1-5 [MP 1.2.c] Status of on-site and off-site species conservation efforts

1) Definition and Importance

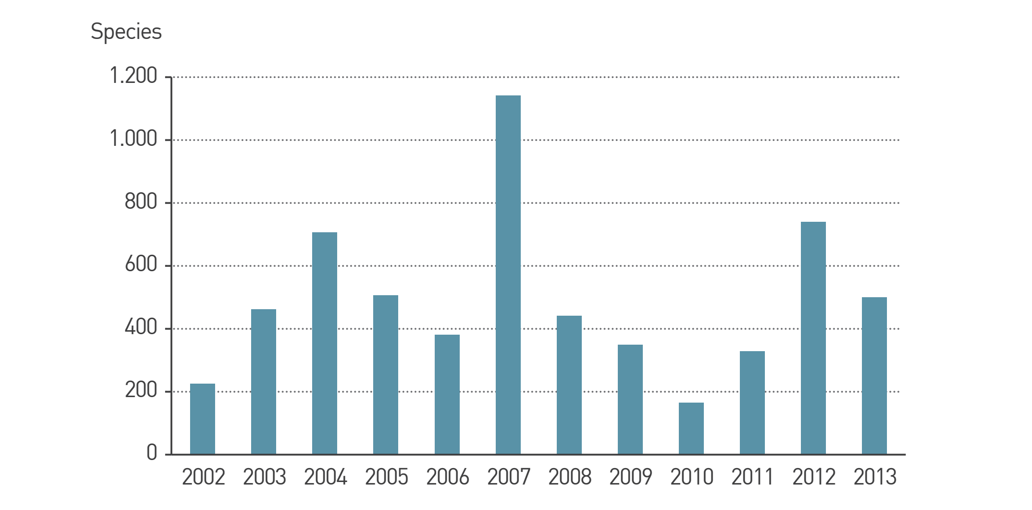
This indicator provides information on various on-site and off-site activities for biodiversity conservations. As certain species are already on the brink of extinction, human intervention to protect such species is required.

2) Data status and trend

Many agencies such as KNA, KFRI, KFSV (Korea Forest Seed and Variety Center), and other public and private arboretums have made off-site efforts to conserve forest biodiversity. Upon opening the Korean National Herbarium (KNH) in 2003 under the KNA, consistent efforts to collect the specimens of plants, insects and fungi have been made, accumulating from 76,000 samples in 2003 to 310,000 in 2007 and to 750,000 samples in 2013. As a result of the forest seed collection project, KNH also possesses seeds



[Figure 1-13] Status of specimens in possession of KNH of KNA in its seed bank for a total of 3,506 species, of which there are 1,851 indigenous species and 1,687 introduced species. KFSV also designated various experimental forests such as clone bank, seed orchard and progeny test stands and gene reserves as off-site forest genetic resources reserves.



[Figure 1-14] Seed collection of species per annum by KNA

On-site and off-site conservation activities for biological diversity are conducted by the forest bioresources implementation plan, and their results are published in the forest bioresources implementation report. The forest bioresources implementation plan is established by the Agricultural and Fishery Life Resources Conservation, Management and Use Act and reports annual national statistics on bioresources.

The forest bioresources implementation report in 2013 presents the results of on-site and off-site activities in ten categories, which are mostly related to off-site conservation efforts and only one category for on-site conservation efforts. The current status of off-site biodiversity conservation shows that KFRI stores 269,798 specimens (26.3%), KNA 550,810 specimens (53.2%), KFSV 215,448 specimens (21.0%), which makes 1,036,056 samples of 20,951 species in total.

As a part of the on-site conservation efforts for rare plants, the natural habitats of 22 species such as *Saccolabium matsuran* in Jeju and *Dendrobium moniliforme* in Wando have been restored, and five species such as *Thrixspermum japonicum* and *Aerides japonicum* are in process of restoration. Moreover, natural habitats improvement efforts for twelve species including *Habenaria radiata* and *Cypripedium guttatum* have been undertaken. With regards to this indicator, on-site conservation activities require continuous support from government as well as improving scientific infrastructure and capacity building for the activities.

[Table 1-8] Status of collection and preservation of forest bioresources in 2013

Types		Locations	# of Species	Numbers in storage	Proportion (%) based on the numbers in storage
Seeds		KFRI	1,106	24,402	73.5
		KNA	1,759	8,548	25.7
		KFSV	43	259	0.8
		Total	2,432	33,209	
Nutritional Compounds		KFRI	100	226,209	50.6
		KNA	5,265	30,105	6.7
		KFSV	180	190,546	42.6
		Total	5,335	446,860	
Microorganisms		KFRI	347	1,639	70.9
		KNA	326	674	29.1
		Total	563	2,313	
DNAs		KFRI	3	326	1.3
		KFSV	12	24,643	98.7
		Total	14	24,969	
On-site conservation groups (ha)		KFRI	16	2,938.8ha	100
		Total	16	2,938.8ha	
Specimens	Plants	KFRI	1,964	17,222	4.6
		KNA	12,402	355,249	95.4
		Total	12,453	372,471	
	Insects	KNA	4,251	156,234	100
		Total	4,254	156,234	
Grand total			20,951	1,036,056 (2,938.8ha)	

[Table 1-9] Summary of the Forest Bioresources Implementation Report 2013

Implementation activities		Results	Category
① Systematic survey and collection of forest plant resources	• Collect resourceful forest plants • Survey of forest genetic resources reserves • Collect & survey domestic/overseas forest plants • Collect & survey forest seeds and varieties • Building infrastructure for forest bioresources specimens	2,387 specimens 42 sites 469 species 191 species 44,378 specimens	Off-site conservation
② Systematic survey and collection of forest insect resources	• Collect forest nematodes • Collect forest pests and their natural enemies • Survey pollinating insects • Survey insects vulnerable to climate change	145 specimens 50 specimens 12 sites 7 sites	Off-site conservation
③ Systematic survey and collection of forest microorganic resources	• Collect mushrooms • Collect vesicular arbuscular mycorrhizae • Research on mushroom diversity	318 strains 5 species 7,848 items	Off-site conservation
④ Strengthening property evaluation of forest plant resources	• Assess genetic diversity of forest genetic reserves • Designate forest genetic resources reserves • Assess genetic diversity of forest seed sources • Develop molecular markers for genetic analysis • Compile DNA profiles of forest bioresources • Assess forest varieties and their breeding properties • Research taxonomy of forest plants	1 species 16 groups 2 species 2 groups 6 species 62 groups 14 species 7 species 6 species 982 cases	N/A
⑤ Strengthening property evaluation of forest insect resources	• Build a taxonomic system for forest insects	50 species	N/A
⑥ Strengthening property evaluation of forest microorganic resources	• Evalute basic properties (medium, temperature, *etc.*) • Research utilisable properties(artificial synthesis, bacillus resistance)	26 species 10 species	N/A
⑦ Strengthening on-site and off-site conservation of forest bioresources	• Develop technology to monitor & manage forest genetic resources reserves • Develop technology to protect and restore rare/special plants • Develop technology to proliferate resourceful plants • Protect clone and varieties reserves	2 species 287 species 1 species 46.8ha	On-site conservation
⑧ Building short and long term seeds and DNA conservation facilities	• Build seeds & DNA bank of resourceful forest plants • Store forest microorganism strains short & long term • Collect & store domestic/overseas forest seeds • Build a gene bank for forest seeds & varieties • Long-term storage of germplasm and assess vitality • Assess vitality of strains in storage • Research physiology of plant seeds	3,199 items 2,633 items 15,347 items 54 species 7 species 100 strains 20 species	Off-site conservation
⑨ Building forest bioresources information database	• Database for resourceful forest resources • Build the Korea Biodiversity Information System • Collect forest seeds & varieties and update knowledge base	2,437 items 151,036 cases 359,010 cases	N/A
⑩ Constructing a clone seedlings production system	• Acquire forest species' somatic embryoic cell lines for clone seedlings production • Induce and select variation of forest bioresources	2 species 42 items	N/A

Indicator 1-6
[MP 1.3.a]

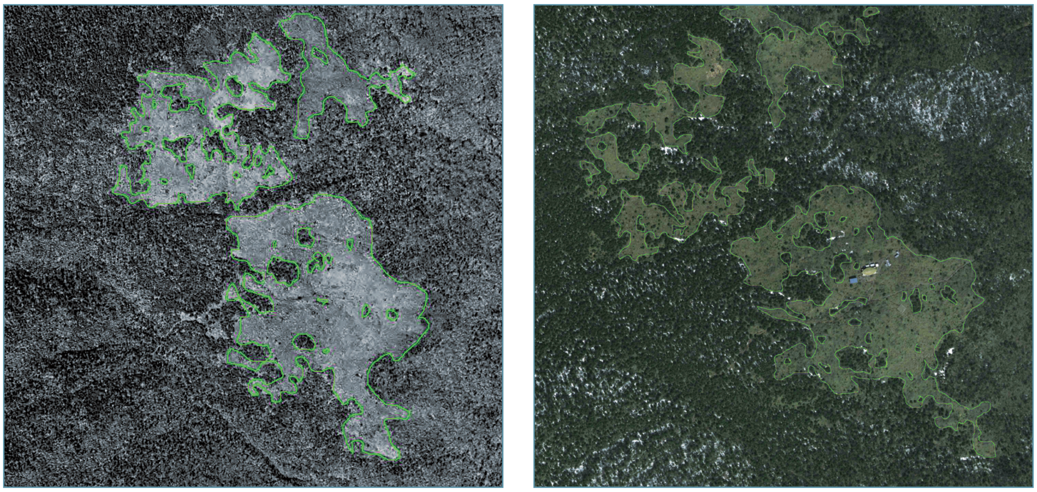
Forest associate species at risk of losing genetic variation and locally adapted genotypes

1) Definition and Importance

This indicator provides information on the number and regional distribution of forest species at risk of losing genetic variation. The loss of genetic variation within a species reduces its adaptability to the future environmental changes and increases the risk of extinction. Groups with unique gene pools in certain areas may face the risk of losing their genotypes by other species introduced either intentionally, unintentionally or naturally.

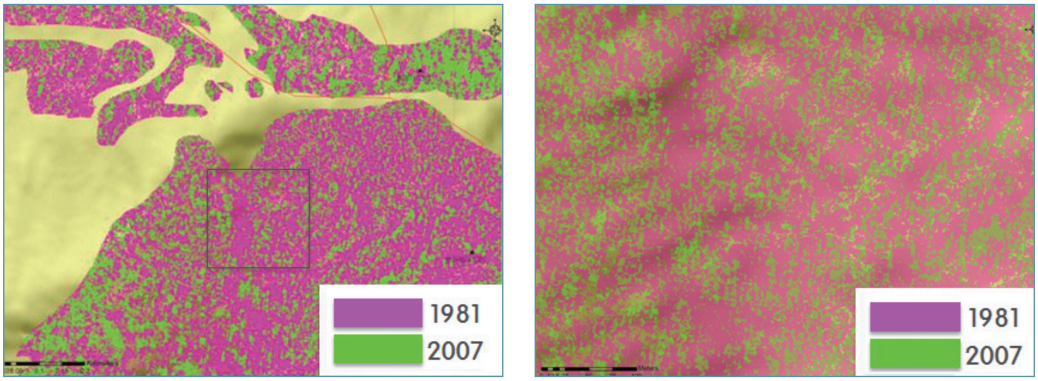
2) Data status and trend

Reduction in genetic variation or loss of genotypes are quite difficult to observe in the perennial living organisms because they have time series characteristics. In case of plant species which have a limited movability, it may be possible to predict the loss of genetic variation from their decline of distribution areas or densities. However, the data is also very rare. A special local tree species, *Abies koreana*, has disappeared one-third from Mt. Hallasan in Jeju. The area of *Abies koreana* forests used to occupy 935.4 hectares in 1967, amounting to 30.2% of the area of Mt. Hallasan, but has declined by 34% to 617.1 hectares in 2003. Temperate zone trees such as *Quercus mongolica* var. *crispula* and *Pinus densiflora* are replacing *Abies koreana*. Due to the temperature rise, alpine forests change to temperate forests, and the distributions of conifer and broadleaf forests are shifting. According to the studies on temperature rise and its impact, it predicted that, if the annual average temperature goes up by 2℃, *Camellia japonica* growing in the southern coastline will expand up to the central inland region including Seoul, and warm temperate forests will also expand to the central region. In case of a 4℃ rise, most of South Korean forests will change to warm temperate forests and the southern coastline to subtropical forests. A representative species of the Korean forests, *Pinus densiflora*, is gradually likely to reduce in population due to the global warming. Korea is a home to both northern and southern plants, possesses a unique ecological and genetic trait in habitats and has many plant species inhabiting the boundaries of southernmost or northernmost regions. Such plants in the marginal areas are very sensitive even to the slight climate change, and especially the alpine plants above an altitude of 1,000m shows a significant decline. Loss of the subalpine plant species draws a special concern such as *Abies koreana* of Mt. Hallasan, *Picea jezoensis* and *Abies nephrolepis* of Mt. Jirisan and *Pinus pumila*, *Taxus caespitosa*, *Arctous ruber*, Rhododendron aureum, and *Anemone narcissiflora* of Mt. Seoraksan.



1967 2009

[Figure 1-15] Changes of distribution areas of *Abies koreana* in the *Rhododendron dauricum* field in Mt. Hallasan



[Figure 1-16] Changes of distribution areas of *Abies koreana* in the Banyabong peak in Mt. Jirisan

Indicator 1-7 [MP 1.3.b] Genetic diversity of the representative forest associate species

1) Definition and importance

This indicator provides information on the genetic diversity of the representative forest species at the group level. Certain species lead or play an important role in the area with regard to forest structure, shape, or succession and the genetic diversity of such species represents the status of forests. Representative species include core species, founder species, flagship species and indicator species.

2) Data status and trend

Genetic diversity is determined by comparing the extent of variation between individual entities or groups. Either way, an evaluation is done based on individual entities, but it can also accompany diverse analyses depending on the study objectives and experimental designs. KFRI has conducted surveys on genetic diversities of representative species since 1972, and after 2004 it has carried out genetic diversity evaluations at the national level by determining the forest genetic resources preservation priorities. It is to seek out the target species group and evaluate its genetic diversity through basic vegetation studies and genetic variation analysis. Depending on the evaluation result, the species group is designated as an on-site conservation forest, or if it proves difficult to protect genetic resources on-site, they are added to a gene bank and an off-site conservation archive through collection and multiplication. The genetic diversity and group genetic structure were analyzed on 233 groups of 25 species using biomarker methods such as Isoenzyme, ISSR, AFLP, cpSSR and nSSR. Among these were 12 conifer species in 128 groups and 13 broadleaf species in 105 groups.

A high score on “genetic diversity” implies a wider level of genetic diversity, and similarly a high score on “group divergence” signifies a greater genetic difference between groups. These scores can be used to develop a genetic resources conservation strategy.

[Table 1-10] Forest genetic diversity evaluation at the national level

Types	Species	# of Groups	Analysis tool	Genetic diversity	Group differentiation
Conifers	*Pinus densiflora*	25	Isoenzyme	He=0.262	G_{ST}=0.039
		19	ISSR	SI=0.453	Φ_{ST}=0.080
		19	cpSSR	He=0.987	Φ_{ST}=0.024
		52	nSSR	He=0.672	F_{ST}=0.031
	Pinus koraiensis	8	Isoenzyme	He=0.208	G_{ST}=0.059
	Pinus thunbergii	13	Isoenzyme	He=0.212	G_{ST}=0.042
	Pinus pumila	1	Isoenzyme	He=0.176	-
	Taxus cuspidata	12	Isoenzyme	He=0.231	F_{ST}=0.282
	Juniperus chinensis	2	Isoenzyme	He=0.283	F_{ST}=0.039
	Thuja koraiensis	3	Isoenzyme	He=0.024	F_{ST}=0.053
	Picea jezoensis	4	Isoenzyme	He=0.077	F_{ST}=0.047
	Abies holophylla	6	ISSR	SI=0.429	Φ_{ST}=0.056
	Abies nephrolepis	8	ISSR	SI=0.265	Φ_{ST}=0.041
	Abies koreana	3	ISSR	SI=0.262	Φ_{ST}=0.094
	Cephalotaxus koreana	16	AFLP	SI=0.344	Φ_{ST}=0.139
Broadleaves	*Acer pictum*	11	Isoenzyme	He=0.160	F_{ST}=0.064
	Machilus thunbergii	10	Isoenzyme	He=0.270	F_{ST}=0.058
	Cornus controversa	9	Isoenzyme	He=0.124	F_{ST}=0.073
	Quercus mongolica	9	Isoenzyme	He=0.222	F_{ST}=0.050
	Quercus variabilis	6	Isoenzyme	He=0.146	F_{ST}=0.028
	Vaccinium uliginosum	2	ISSR	SI=0.470	Φ_{ST}=0.335
	Stewartia pseudocamellia	11	ISSR	SI=0.390	Φ_{ST}=0.285
	Berchemia berchemiifolia	5	ISSR	SI=0.182	Φ_{ST}=0.089
	Acer tegmentosum	8	ISSR	SI=0.348	Φ_{ST}=0.138
	Ulmus davidiana	8	ISSR	SI=0.474	Φ_{ST}=0.083
	Exochorda serratifolia	9	ISSR	SI=0.407	Φ_{ST}=0.278
	Phellodendron amurense	4	ISSR	SI=0.401	Φ_{ST}=0.047
	Tilia amurensis	13	AFLP	SI=0.416	Φ_{ST}=0.105

※SI= Shannon's diversity index
He= Heterozygosity

Indicator 1-8 [MP 1.3.c]

Status of on-site and off-site genetic diversity conservation efforts

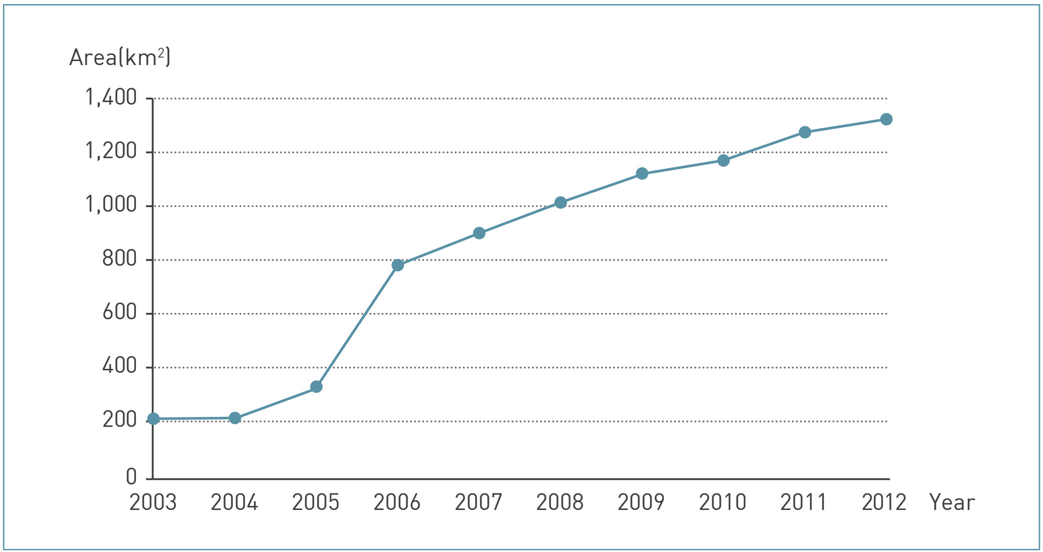
1) Definition and importance

This indicator provides information that describes on-site and off-site efforts to conserve the genetic diversity. Some species are at risk from the loss of genetic variation as a result of group decline or disappearing habitats. A continuous decline of genetic variation threatens the survival of the species and may accelerate its decline to the point of extinction. On-site conservation efforts include a search for the distribution of new individuals as well as conservation of genetic diversity. Off-site conservation includes off-site conservation reserves and a seed bank and a gene bank to collect genetic materials.

2) Data status and trend

The Korean conservation reserves include the forest genetic resources reserves, the Baekdudaegan reserves, the ecosystem and landscape conservation reserves, wetland reserves, wildlife reserves, special islands, national/public parks and natural protection reserves, which are managed by such entities as the Ministry of Environment, the Korea Forest Service, the Ministry of Land, Infrastructure and Transport and the Cultural Heritage Administration. The forest genetic resources reserves under the management of KFS are 599 sites, occupying 149,432 hectares as of 2013, and the number and area of sites are increasing every year. With regard to the dominant species, the reserves are occupied by 26% of *Pinus densiflora*, 25% of *Abies koreana*, 28% of oak trees and 5% of *Taxus cuspidata*, *etc*., and are composed of such few core species. The reserved areas which have been undertaken for the evaluation of genetic diversity in relation to the core species are only 2.2% of the total area as 2,939 hectares.

KFRI and KFSV are main actors, conducting off-site conservation efforts with a focus on genetic variation. Since 1962 the clone archives has been established in 52.3 hectares of 11 conifer species with 1570 clones such as *Pinus densiflora*, and 26.2 hectares of 11 broadleaf species with 765 clone such as *Populus davidiana*, totalling 78.5 hectares of 22 species with 2,335 clones. Since 1968, the seed orchards has been managed for 15 conifers such as *Chamaecyparis obtusa* in the area of 593.2 hectares and 41 broadleaves such as *Betula costata* in 108.8 hectares. The varieties archives were established in 30 hectares, accommodating 53 species and 1,718 varieties such as *Castanea crenata* to supply various breeding materials for crossbreeding and selection. Such off-site conservation efforts have been made in the process of the studies on forest tree breeding.



[Figure 1-17] Changes in designated areas of the forest genetic resources reserves

Dongbaekdongsan_genetic resources reserve in Jeju island(Chun, Jung Hwa)

Criterion 2 Maintenance of productive capacity of forest ecosystems

Indicator 2-1	Area and percent of forest land and net area of forest land available for timber production
Indicator 2-2	Total growing stock and annual growth volume by forest type in the net area of forest land available for timber production
Indicator 2-3	Area and growing stock of plantations of native and exotic species
Indicator 2-4	Annual wood harvest by volume and as a percentage of net growth

Maintenance of productive capacity of forest ecosystems

Productive capacity of forest ecosystems shows the potential availability of forests to directly or indirectly provide a wide range of goods and services. This criterion implies both the ecological and environmental aspects to sustain the productive capacity of forests through the efficient use of forest land and the economic aspect to enhance the productive capacity of forest ecosystems through an intensive management plan.

Annual harvest of wood and non-wood products should not exceed annual growth in an eco-friendly and sustainable way which makes the productivity of forests maintained and able to reproduce in perpetuity. Thus, preventing the depletion of wood and non-wood products from external interferences through the implementation of SFM is essential to maintain the forest productive capacity.

Indicator 2-1 [MP 2.a] Area and percent of forest land and net area of forest land available for timber production

1) Definition and importance

This indicator provides information on the forest area being able to produce timber by age class. It helps understand the changes in the forest area available for timber production by age class, and enables to project the future timber supply volume.

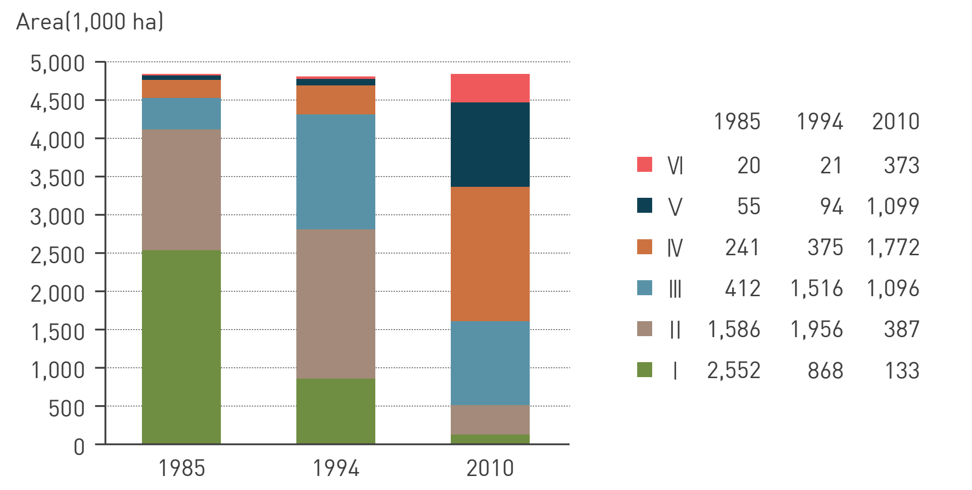
2) Data status and trend

A forest land where a main purpose for its management is for timber production with a forest management plan is classified as a working forest, while a forest protected by law such as a forest conservation reserve is classified as a work-restrictive forest. The working forests in the stocked forest lands except for the bamboo forests were considered the forest area available for timber production.

By the end of 2010 forest areas occupy 6,368 thousand hectares, 63.7% of the national territory, of which is the working forest of 5,023 thousand hectares. Except for the bamboo forests and the un-stocked forests, the net working forest area is about 4,860 thousand hectares, accounting for 76.3% of the total land base. In the working forests, the distribution of age class I, II and III are declining, while age class IV, V and VI are increasing greatly. The increase of the forest areas at the cutting age and the mature forests implies that a harvesting volume is very small compared to the net growth volume of forests.

[Table 2-1] Working forest and work-restrictive forest by age class (Unit : 1,000 ha)

Type		Total	Stocked forest								Un-stocked forest
			Sub-total	I	II	III	IV	V	VI	Bamboo forest	
Total	'85	6,512	6,268	3,259	2,044	525	313	87	34	5	244
	'94	6,456	6,274	1,077	2,526	2,012	470	138	44	8	181
	'10	6,368	6,171	160	466	1,396	2,261	1,387	492	7	197
working forest	'85	5,073	4,870	2,552	1,586	412	241	55	20	4	203
	'94	4,967	4,836	868	1,956	1,516	375	94	21	7	131
	'10	5,023	4,866	133	387	1,096	1,772	1,099	373	6	157
work restrictive forest	'85	1,439	1,397	708	458	113	72	33	14	1	42
	'94	1,488	1,438	209	570	496	95	44	23	1	50
	'10	1,345	1,305	27	79	300	489	289	118	1	40



[Figure 2-1] Changes in working forest areas by age class

Indicator 2-2
[MP 2.b]

Total growing stock and annual growth volume by forest type in the net area of forest land available for timber production

1) Definition and importance

This indicator presents the growing stock and annual growth volume in the net area of forest land available for timber production in order to meet the timber demand. This indicator also provides a useful information on estimating the annual allowable cut (AAC) as a ratio of net growth or sustained yield of harvest in relation to the indicator 2-4 (MP 2.d).

2) Data status and trend

The total growing stock of forest areas available for timber production is about 626 million m^3, and the total working forest area of 4,860 thousand hectares possesses an average growing stock of 129 m^3 per hectare. Compared to the growing stock of 229 million m^3 in 1995 as a result of the 3rd National Forest Survey (NFS), the growth volume of the working forest area has annually increased by 26,517 thousand m^3 in average during the past fifteen years. By converting it to an annual growth volume per ha, it appears to have grown 5.4 m^3 in average.

In addition, as the annual harvest volume in 2010 was 3,726 thousand m^3 as only 14% of the average annual growth volume, it indicated that only a very small portion of the annual available cut was produced.

[Table 2-2] Growing Stocks of working forests by forest type and age class (Unit : 1,000 m^3)

Type		Total	Age-class					
			I	II	III	IV	V	VI
Total	1995 (3rd NFS)	228,668	-	78,945	93,386	40,241	12,927	3,170
	2010 (5th NFS)	626,433		22,131	123,499	239,237	172,369	69,191
Conifers	1995	109,718	-	44,144	44,484	16,933	2,832	1,325
	2010	271,837	-	14,368	66,920	106,009	68,180	16,359
Broadleaves	1995	58,907	-	11,380	24,849	13,789	7,804	1,085
	2010	163,559	-	3,773	21,134	51,910	51,917	34,823
Mixed	1995	60,042	-	23,421	24,052	9,519	2,290	759
	2010	191,037	-	3,990	35,445	81,318	52,272	18,009

Indicator 2-3
[MP 2.c]

Area and growing stock of plantations of native and exotic species

1) Definition and importance

This is an indicator to measure the extent of plantations by the management entities in charge of national, public and private forests to satisfy the market demand on the rise. The forest products obtained from the intensively managed plantations may have a positive impact on the biodiversity and a supplementary effect on the demands of goods and services produced from the native and natural forests. Even though establishing plantations by planting both native and exotic species may increase the range and quantity of potential goods and services from the forests, it may cause an unintended environment effect in certain circumstances.

This report quotes the annual plantation species statistics from the Statistical Yearbook of Forestry from the KFS to explain for this indicator. However, because the species statistics shows only the area and the number of seedlings planted for six conifer species and six broadleaf species, this report presents only the planted areas for native and exotic species in recent 5 years. The statistics on the status of forest areas and growing stocks by species has a limitation to use because plantation forests are largely classified into both conifers and broadleaves without specifying individual species except for *Larix kaempferi* and *Pinus rigida*.

2) Data status and trend

Plantation species in Korea are divided into conifers and broadleaves. Of the conifers, native species are mainly *Pinus densiflora*, *Pinus koraiensis* and *Pinus thunbergii* and exotic species *Larix kaempferi*, *Cryptomeria japonica* and *Chamaecyparis obtusa*. From 2008 to 2012 *Pinus densiflora* was planted the most among the local conifer species, and *Chamaecyparis obtusa* among the exotic conifer species.

[Table 2-3] Plantations of native and exotic species (conifers)

Year	Total	Native species			Exotic species			Others
		Pinus densiflora	*Pinus koraiensis*	*Pinus thunbergii*	*Larix kaempferi*	*Cryptomeria japonica*	*Chamaecyparis obtusa*	
2008	8,699	3,410	1,935	504	505	31	1,622	692
2009	8,768	3,203	1,575	650	962	18	1,656	704
2010	9,489	4,572	1,482	535	805	24	1,495	576
2011	8,522	4,098	1,408	358	712	6	1,449	491
2012	9,560	4,564	1,759	301	463	43	1,872	558

Of the broadleaves, local native species mainly include *Acer pictum*, *Zelkova serrata*, *Fraxinus rhynchophylla*, *Prunus serrulata* and *Quercus acutissima*, and exotic species *Betula platyphylla*. During 2008 to 2012 *Quercus acutissima* among oaks was planted the most among the native broadleaf species, and *Betula platyphylla* was planted the most among the exotic broadleaf species in the areas of 1,377 hectares in 2010. Since then it has gradually declined.

[Table 2-4] Plantations of native and exotic species (broadleaves)

Year	Total	Local species					Exotic species	Others
		Acer pictum	*Zelkova serrata*	*Fraxinus rhynchophylla*	*Prunus serrulata*	*Quercus acutissima*	*Betula platyphylla*	
2008	13,132	232	566	215	4,349	1,441	232	6,097
2009	12,784	140	434	62	3,978	1,288	140	6,742
2010	12,026	207	398	273	432	3,029	1,377	6,310
2011	12,657	91	343	199	515	2,671	775	8,063
2012	10,479	110	205	42	410	1,410	637	7,665

Indicator 2-4 [MP 2.d] Annual wood harvest by volume and as a percentage of net growth

1) Definition and importance

To harvest just as much as the annual growth volume is a base for sustainable forest management. Therefore, it serves as an indicator of maintaining the managed forest within a sustainable range of production. The forest production statistics from the annual Statistical Yearbook of Forestry of the KFS are used to explain for this indicator, with the wood production by volume (m^3) and as a ratio of the net growth volume (%) from 2006 to 2010.

2) Data status and trend

The majority of timber production in Korea comes from thinning, cutting damaged trees or regenerating tree species rather than final harvesting. During 2006 to 2010, timber production has gradually increased. As well the ratio of wood production over the net growth volume is slightly increasing, but it only amounts to approximately 10% of the total net growth volume as of 2010.

[Table 2-5] Wood production versus the net growth volume

Year	Wood production (m^3) A	Net growth volume (m^3) B	Ratio (%) A/B
2006	1,615,872	25,525,458	6.3
2007	1,702,440	26,803,585	6.4
2008	1,995,015	34,721,923	5.7
2009	2,515,694	37,707,967	6.7
2010	3,725,604	37,012,474	10.1

Criterion 3 Maintenance of forest ecosystem health and vitality

Indicator 3-1 Forest area affected by biotic processes and agents (forest pests and diseases)

Indicator 3-2 Forest area affected by abiotic causes (fire, typhoon and landslide)

Maintenance of forest ecosystem health and vitality

Since forest species and ecosystems slowly adapt to the environmental conditions such as local geology and climate over a long time, they are vulnerable to the rapid changes in environmental conditions from natural disasters or human-induced disturbances. In particular, indiscreet human interventions to forests inevitably cause negative impacts on the health and vitality of forest ecosystems by introducing invasive species and pests and diseases. In such cases the function of forests may be declined or lost. Therefore it is important to monitor the trend of changes in order to rehabilitate the degraded forest by establishing forest management strategies.

Forest fires are mostly human induced, and it requires a long time and efforts to reverse the damage of forest fires on forest ecosystems. Landslides from typhoons cause a damage to vegetation and wash away foundational soil with their organic components, resulting in severe degradation of forests and the ecosystem of mountain streams.

This criterion assesses the extent of forest affected by biotic and abiotic factors such as pests and diseases, forest fires and landslides which give an adverse impact on the health and vitality of forest ecosystems in Korea.

Indicator 3-1 [MP 3.a] Forest area affected by biotic processes and agents (forest pests and diseases)

1) Definition and importance

This indicator assesses the damage on the health and vitality of forest ecosystems caused by forest pests and diseases, which are projected to spread further due to climate change. Using the accumulated data on pests and diseases, the trend of occurrences has been analyzed in order to effectively respond to the future risks and establish the budget required for protection of forests. The forest ecosystem health and vitality can be significantly improved through early monitoring and timely control by analysing the status of occurrences of forest pests and diseases.

2) Data status and trend

Forest pests and diseases are a product of complex interactions within a forest ecosystem. The types of pests and diseases occurred may be different by changes of ecosystem structure such as forest cover change and increasing growing stock. Moreover, new pests and diseases may emerge from global warming and climate changes.

The four major forest pests and diseases in Korea are *Bursaphelenchus xylophilus* (Pinewood nematode), *Thecodiplosis japonensis* (Pine needle gall midge), *Matsucoccus thunbergianae* (Black pine bast scale) and *Raffaelea quercus-mongolicae* (Oak wilt), and the other forest pests are *Dendrolimus spectabilis* (Pine caterpillar), *Hyphantria cunea* (Fall webworm), *Agelastica coerulea* (Japanese alder leaf beetle), *Acantholyda parki* (Korean pine webworm) and *Lycorma delicatula* (White). In particular, the prevalence of some forest pests and diseases are shifting to a decline due to the efficient and timely monitoring and prevention system in consideration of local special conditions even though the risks of frequent occurrences and spread of the existing and newly introduced pests and diseases are increasing due to climate change.

Since the first appearance in 1988, the affected areas by pinewood nematode were declining by active control measures such as enacting the Special Act on Pine Wilt Disease Control in 2005, scaling up human and financial resources and improving control methods. However, it is rapidly spreading from 2013 due to the climate factors of high temperature and drought, combined with the human induced factors such as neglected dead trees and transportation of infested trees. The number of affected trees has risen again recently from 863,000 trees in 2005 to 1,369,000 trees in 2006, to 639,000 trees in 2007, to 133,000 trees in 2010, to 506,000 trees in 2012 and to 1,537,000 trees in 2013. The affected forest areas are showing the same trend as sharply increasing since 2012.

Pine needle gall midge was increasing between 2005 to 2008, but began to decline after 2008. Black pine bast scale has also been on a decline, although it was on a steady rise until 2007. The first case of oak wilt disease took place in Seongnam, Gyeonggi-do in 2004, and peaked in 2008. Since then it declined, but in 2011 it reemerged in the metropolitan Seoul and Chungbuk-do areas, causing much damages ever since. However, as a result of active measures such as introducing diverse preventive methods to minimize infestation from pests and diseases, the incidence of major forest pests and diseases has been on a decline.

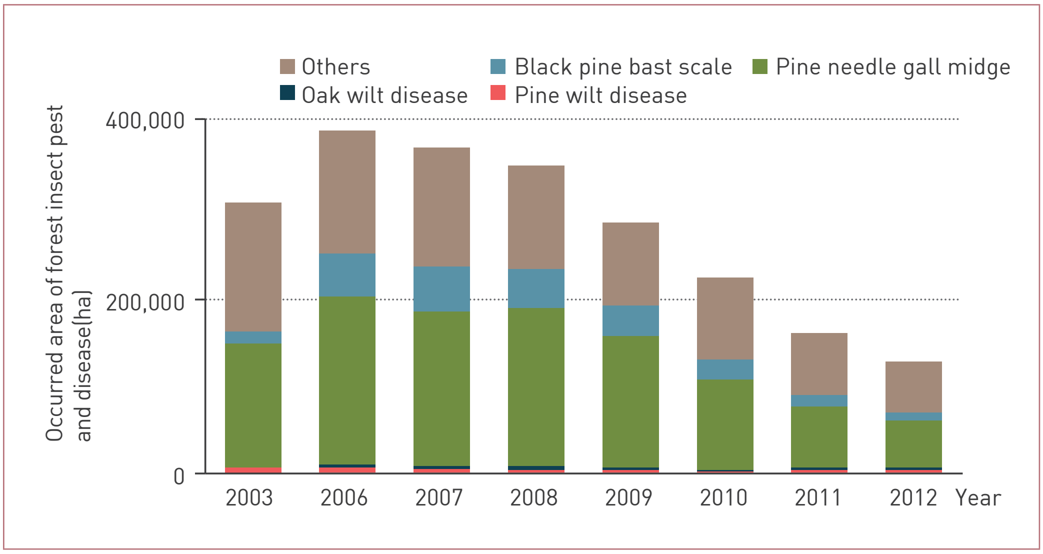
According to the pine wilt disease occurrence statistics, as infested pines wilts away after a certain period of time, it requires consistent monitoring against additional infestation and insects agents to prevent from spreading by recurrence. Accordingly, the comprehensive forest pests and diseases control system is being renovated to improve, being able to reduce the pine wilt disease to a manageable level in the long term by steadily expanding aerial and ground controls. With regards to combating the spread of oak wilt disease, it is expected to reduce the damage by early monitoring and timely

[Table 3-1] Affected areas by forest pests and diseases

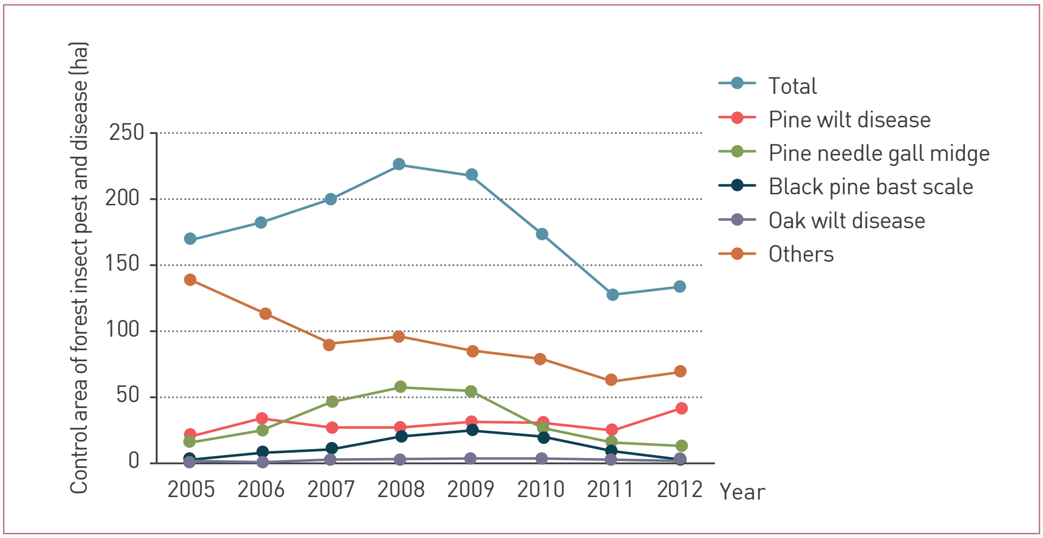
(Unit : ha)

Year	2005	2006	2007	2008	2009	2010	2011	2012
Total	315,607	389,955	371,539	353,125	290,404	225,345	167,084	137,397
(Change over the year before, %)	29.86	23.56	-4.72	-4.96	-17.76	-22.4	-25.9	-17.8
Bursaphelenchus xylophilus	7,811	7,871	6,855	6,015	5,633	3,547	5,123	5,286
Thecodiplosis japonensis	148,846	195,759	179,585	183,229	155,897	113,123	82,125	68,031
Matsucoccus thunbergianae	11,988	45,146	47,207	41,210	32,497	21,855	12,524	8,945
Raffaelea quercus-mongolicae	0	1,944	3,591	4,087	2,489	1,812	3,307	2,680
Other pests	146,962	139,235	134,301	118,584	96,377	85,008	64,005	52,455

control through implementation of complete control by local regions and operation of monitoring units in cooperations among responsible agencies. Fast response and control of forest pests and diseases have become critical in maintaining the health of forest ecosystems when climate change such as unusual temperature gets deepened.



[Figure 3-1] Trend of areas affected by forest pests and diseases



[Figure 3-2] Controlled areas of forest pests and diseases

[Table 3-2] Controlled areas of forest pests and diseases

(Unit : 1,000 ha)

Year	2005	2006	2007	2008	2009	2010	2011	2012
Controlled area	170	184	202	227	220	175	129	135
Bursaphelenchus xylophilus	21	34	29	27	32	31	27	42
Thecodiplosis japonensis	17	26	48	57	55	28	16	13
Matsucoccus thunbergianae	3	8	10	21	26	20	10	5
Raffaelea quercus-mongolicae	0	1	4	5	5	4	2	5
Other pests	139	115	91	97	87	79	62	70

Indicator 3-2 [MP 3.b] Forest area affected by abiotic causes (fire, typhoon and landslide)

1) Definition and importance

This indicator assesses the overall area affected by abiotic disasters such as forest fires and landslides. They cause not only a massive destruction of trees but also soil, a foundation of a forest ecosystem, which takes much time and effort to recover from the damage. Assessment of the affected areas by forest fires and landslides helps establish forest management strategies toward restoring the forest functions.

2) Data status and trend

There have been 387 forest fires on annual average between 2003 and 2012, causing damages over 734 hectares of forests in total. It stems from a low-precipitation clear days in spring, resulting in a low relative humidity and accumulation of dry leaves. The dominant cause of forest fires has been people's mistakes from hikers and agricultural field burning, amounting to about 59% of all cases. From 2003 to 2012 the forest fires occurred the highest in the southeastern region. By provinces, Gyeongbuk-do, including Daegu, had the highest incidence of forest fires as 22%, followed by Gyeongnam-do, including Busan and Ulsan, 21%, Gyeonggi-do, including Seoul and Incheon, 14% and Jeonnam-do, including Gwangju, 14%.

There were total 197 forest fires in 2012 with damaged areas of 72 hectares. It was a major decline as it was only 46% and 6% of the annual average incidence and damaged area, respectively, compared with the annual average of 387 fires with a damaged area of 734 hectares over 2003 to 2012. The incidence of forest fires is at its lowest in the recent 20 years, with the damaged area at its lowest since the foundation of KFS. In spring season from Feb. 1 to May 15, there were 102 incidences with damaged forests of 49 hectares, while in autumn season from Nov. 1 to Dec. 15 there were 6 incidences with damage of only 1 ha. In terms of the causes of forest fires, the majority was human induced mistakes, which were accidental burning 16% (agricultural field burning 9% and trash incineration 7%) and accidental fires by hikers 42%, totalling 58%. It is worth noting that a series of weather anomaly triggered 22 fires from lightening strikes.

In ordinary year forest fires mainly occurred between March and April. But in 2012 they tended to continue until May and June. The monthly occurrences showed that 15% of fires occurred in February, 25% in March, 28% in April, 6% in May and 3% in June for the recent 10 years, and 5% in February, 12% in March, 23% in April, 27% in May and 18% in June for 2012. By a local region, Gangwon-do had the highest incidence of 44 as 22%, followed by Gyeongnam-do 25 cases as 13% and Gyeongbuk-do 23 cases as 12%.

[Table 3-3] Trend of forest fires from 2003 to 2012

Classification	10 yr avg.	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
No. of fires	387	271	544	516	405	418	389	570	282	277	197
Damaged areas	734	133	1,588	2,067	254	230	227	1,381	297	1,089	72
Average damaged area per fire	1.90	0.49	2.92	4.01	0.63	0.55	0.58	2.42	1.05	3.93	0.36

[Table 3-4] Causes of forest fires from 2003 to 2012

Type	10 yr avg.		'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
	Incidence	Proportion (%)										
Total	387	100%	271	544	516	405	418	389	570	282	277	198
Hikers' mistake	165	42%	93	250	232	185	193	149	222	138	110	83
Field burning	66	17%	55	83	95	63	92	63	94	38	66	18
Trash incineration	37	9%	24	47	41	40	21	44	68	34	39	13
Cigarette burning	33	8%	43	51	60	26	37	49	34	13	12	10
Cemetery visitors	20	5%	31	22	24	12	23	26	36	15	11	7
Fireworks by Children	7	1%	4	13	13	14	7	6	6	1	3	3
Others	56	14%	21	78	51	65	45	52	110	43	36	64

In terms of the extent of damaged area, small fires with a damaged area under 1 ha occurred 183 times, accounting for 92% of the total forest fires in 2012, making it a year record without a big forest fire. The overall trend of forest fires in 2012 demonstrated that most of forest fires which commonly took place in the metropolitan areas and their vicinity with a high population density shifted to the inland areas of Gyeongbuk-do and west region of Gangwon-do.

[Figure 3-3] Fire in pine forest (Yangyang-gun, Gangwon Province, 2005)

[Figure 3-4] Damaged area after forest fire (Yangyang-gun, Gangwon Province, 2005)

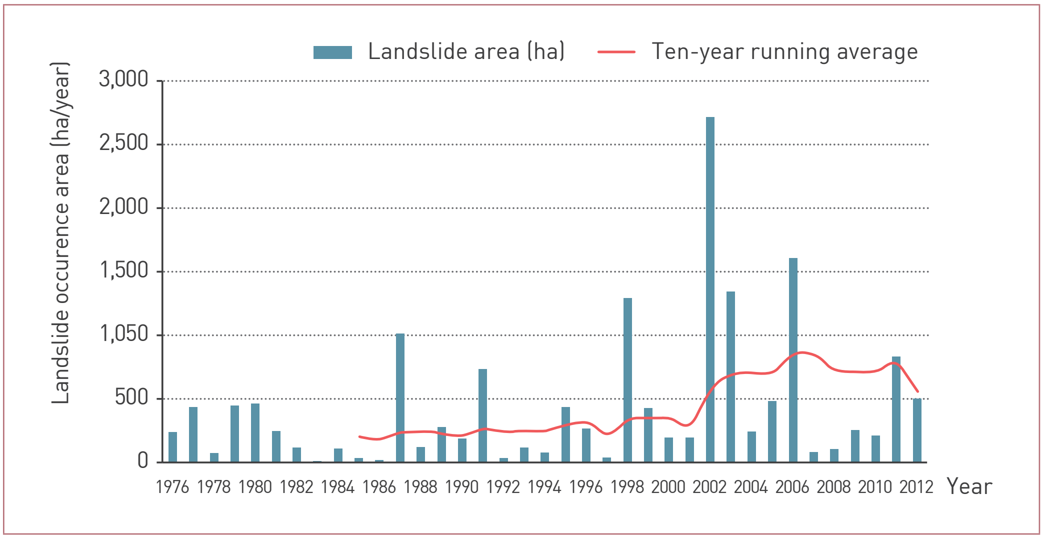
As a result of typhoons and heavy rains during summer time, the annual average area of landslides from 2003 to 2012 was 558 hectares, which was 2.4 times than 231 hectares of the 1980s. However, in terms of the landslides compared in a 5-year period during the last decade, the landslide area decreased by 1,829 hectares from 3,702 hectares between 2003 to 2007 to 1,873 hectares during 2008 to 2012. The reason was that there were large scale typhoons such as ‘Maemi’ in 2003,‘Dianmu’ in 2004, ‘Nabi’ in 2005 and ‘Ewiniar’ in 2006, which caused landslides frequently. The total landslide area in 2012 was 491 hectares, down by 40% from 824 hectares in 2011, and at 88% of the annual average occurrence of 558 hectares from 2003 to 2012. There was one loss of human life in 2012 by the typhoon ‘Sanba’, and it was a huge reduction, compared with that of 2011 when there were many human losses from the landslides in Mt. Woomyeonsan in Seoul and Mt. Majeok in Chuncheon.

[Table 3-5] Damages and recovery costs of landslides from 2003 to 2012

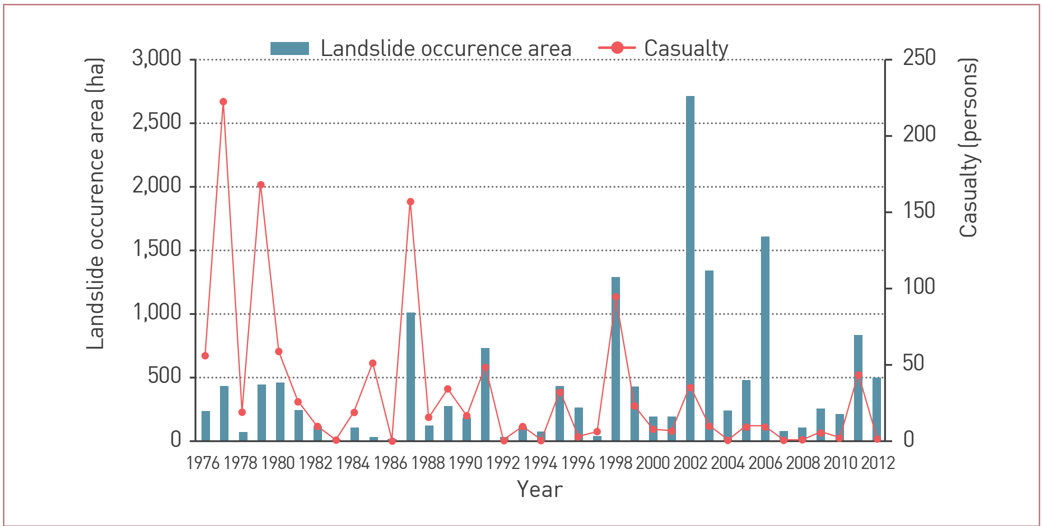
Year	Damages			Recovery cost (million Won)		Duration of damages
	Landslides (ha)	Forest roads (km)	Human loss (Death)	Forests overall	Erosion controls & forest roads	
Annual average	558	96	11	111,808	106,370	
Total	5,575	959	78	1,118,084	1,063,700	
2003	1,330	362	10	227,816	206,659	1st(6.18.~6.19./typhoon "Soudelor") 2nd(7.9.~7.13.) 3rd(7.22.~7.25.), 4th(8.6.~8.7.) 5th(8.23.~8.27.) 6th(9.12~9.13/typhoon "Maemi")
2004	233	76	-	40,912	39,997	1st(6.19.~6.21./typhoon "Dianmu") 2nd(7.12.~7.17.) 3rd(8.17.~8.19./typhoon "Megi") 4th(9.11.~9.12.)
2005	469	75	9	99,745	98,015	1st(6.30.~7.2.), 2nd(8.2.~8.3.) 3rd(8.8.~8.11.) 4th(9.6.~9.8./typhoon "Nabi") 5th(9.17~9.18)
2006	1,597	227	9	319,189	315,078	1st(7.9.~7.29./typhoon "Ewiniar") 2nd(10.22.~10.24.)
2007	73	45	-	20,436	19,096	1st(8.4.~8.15.) 2nd(9.1.~9.18./typhoon "Nari")
2008	102	18	-	19,342	18,883	1st(7.23.~7.26.)
2009	250	39	5	69,594	68,634	1st(7.7.~7.8.), 2nd(7.11.~7.16.)
2010	206	44	1	49,585	40,172	1st(7.16.~7.18.), 2nd(7.23.~7.24.) 3rd(8.13.~8.18.) 4th(9.1.~9.2./typhoon "Kompasu") 5th(9.21~9.22.)
2011	824	43	43	157,961	156,785	1st(7.7.~7.16.), 2nd(7.26.~7.28.) 3rd(8.6.~8.10./typhoon "Muifa")
2012	491	30	1	119,322	100,381	1st(8.12.~8.16.) 2nd(8.25.~8.30. /typhoon "Bolaven & Denvin") 3rd(9.15.~9.17./typhoon"Sanba")

※No typhoon marking implies a heavy rain period.

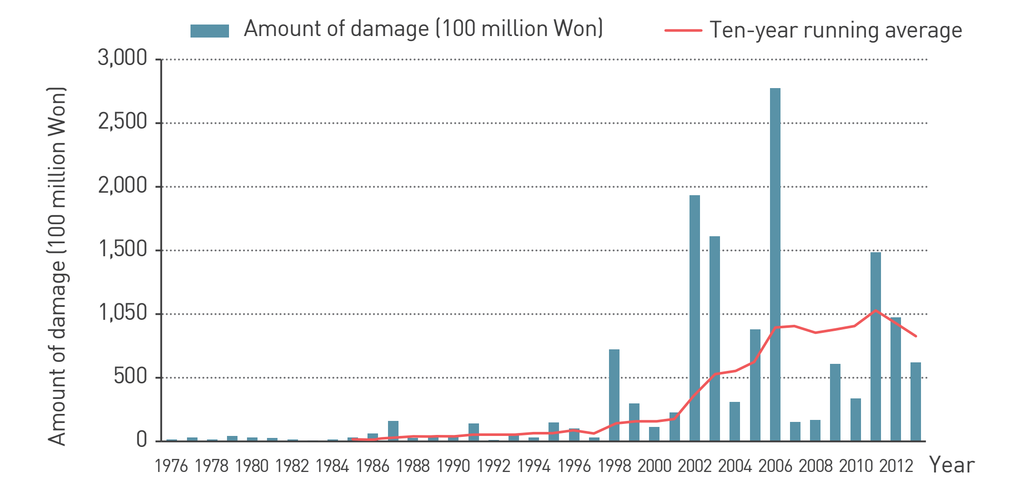
In terms of the human loss from landslides in detail, before the 1980s it took up 29% of the human loss by the total natural disasters, but after the 1980s it reduced down to 13%. It appears to be a result of exodus from agricultural areas and erosion control efforts. However, there is a slight change in the declining trend of human loss again. In the recent five years, landslide areas have decreased to 2,083 hectares from 2,474 hectares of the previous five-year period, while the human loss has increased from 18 to 54 at the



[Figure 3-5] Trend of landslide occurrence areas



[Figure 3-6] Casualties over landslide occurrence areas by year same period. The causes of increased human loss mainly come from forest developments for urbanization and inactive erosion controls in urban areas. The potential threat by landslides to the human loss in populated metropolitan areas is getting bigger.



[Figure 3-7] Recovery costs for landslide occurrence areas

[Figure 3-8] Scene of landslide areas in Gangneung-si, Gangwon Province (2002)

[Figure 3-9] Scattered landslide areas in Pyeongchang-gun, Gangwon Province (2002)

Criterion 4 Conservation and maintenance of soil and water resources

Conservation and maintenance of soil and water resources

Soil and water resources are essential components of terrestrial ecosystems. Soil shelters plants and animals, supplies water and nutrition and filters pollutants. More than 75% of all living things are made up of water, which serves as a substance solvent and a means of transport. Thus, soil and water play an important role in the lives of both humans and wildlife. Their quantity and quality have a substantial impact on the makeup of a forest ecosystem and determine its socioeconomic values.

Forest fire, landslide and illegal conversion of forest land may disturb the soil and change its properties. Substantially the changes in physical and chemical properties of soils resulting from natural and human factors are being observed by a long-term monitoring. Furthermore, soil disturbances by forest fires and landslides may cause a change in water temperature and soil runoff as well as a higher level of turbidity, resulting in degradation of water quality and aquatic ecosystem.

Erosion control measures for hillsides, torrents and forest watersheds are effective forest management activities for soil and water protection. The effects of forest tending activities such as forest thining and natural forest tending can be dealt with in terms of water conservation and water retention of forests.

Changes in numerous functions of soil and water resources can be measured by a long-term monitoring, and by comparing with a healthy forest ecosystem, reduction or recovery of functions in soil and water resources at a permanent sampling site can be detected.

Indicator 4-1 [MP 4.1.a]

Designated forest area for conservation of soil and water resources

1) Definition and importance

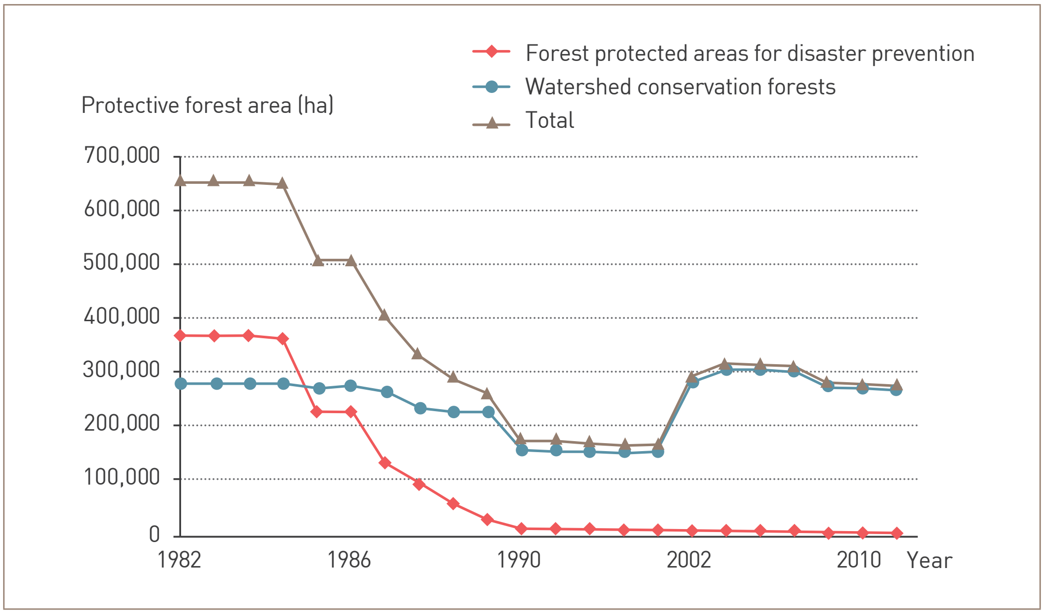
This indicator presents the forest area designated and managed for soil and water resource conservation. Since 64% of the Korean territory is comprised of forests, the majority of water resources rises from the forests. In other words, forests retains water from precipitation and releases it back to reservoirs and rivers, serving as a dynamic water source. Forests also cover the land surface to protect soil and prevents erosion. Thus, the state of conservation and management of forests gives a direct impact on the quantity and quality of soil and water resources. This indicator explains the current status and the changes in forest reserves designated for prevention of soil erosion and landslide as well as protection of water resources.

2) Data status and trend

There are many types of forest reserves designated and managed for protection of soil and water resources and promotion of public welfare services. The forest protection scheme is best represented by the forest reserve system that its history goes back to 1908. In the beginning there were many types of forest reserves such as prevention of soil erosion and runoff, prevention of shifting sand dune and tidal damage, rock falling prevention, forest for fish shelters and watershed conservation forest. The forest reserves were integrated into two types through several revisions of the related laws. One is the disaster prevention forest reserves to protect soils, and the other watershed conservation forests to protect water resources.

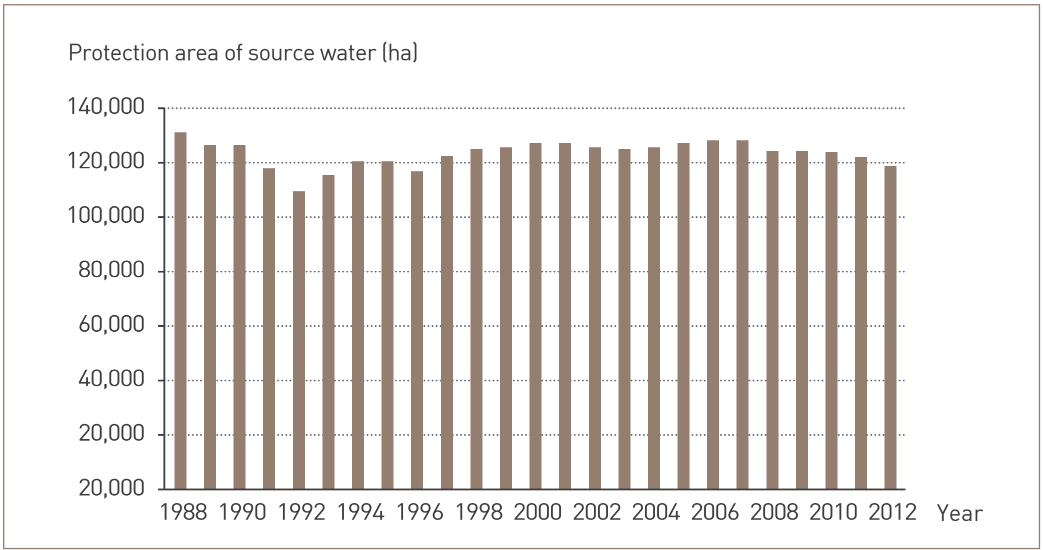
The disaster prevention forest reserves integrate soil erosion prevention forests, shifting sand dune prevention forests, rock falling prevention forests, tidal damage prevention forests and fish habitats forests, and are designated in 5,000 hectares in total as of 2012. It was up to 367,000 hectares in 1970, down to 228,000 hectares in 1980 and downsized to 16,000 hectares in 1990. It has been on a steady decline ever since because the disaster prevention forest reserves designated for purposes of reforestation and erosion control prior to the 1970s significantly decreased by the end of the 1980s as a result of the successful implementation of the first 10-year national forest rehabilitation project in 1978, followed by readjustment of erosion control sites and protection forests.

Watershed conservation forests are designated in 269,000 hectares of forests to protect water resources as of 2012. In 1970 there were 282,000 hectares of watershed conservation forests, but after two maintenance efforts the total area reduced to 177,000 hectares in 1990. Since the social demand for clean water increased greatly after the mid 1990s, it increased again to 292,000 hectares, following the designation of the class III watershed conservation forests enforced in 2000. The watershed conservation forests expanded to 307,000 hectares by 2002. Since then, it slightly declined.



[Figure 4-1] **Trend of designated forests for soil and water resources**

There are 119,000 hectares of water protection zones, designated nationwide to protect upstream water sources and maintain water quality as of 2012. Even though the total area designated for upstream water protection decreased from 131,000 hectares in 1988 to 109,000 hectares in 1992, there have been only minor changes with a slight up and down.



[Figure 4-2] Trend of designated zones for upstream water protection

Indicator 4-2 [MP 4.2.a] Erosion control achievements to protect forest soil resources

1) Definition and importance

This indicator represents the area and proportion of forests under management for soil protection by silvicultural practices or other related legislations. It explains the status and changes of hillside erosion control projects that are representative forest management activities for protection of soil resources. Erosion control is a typical means of soil preservation in forest management, and it includes all means of soil stabilization and forest restoration in places such as denuded lands and slipped or near-slipped lands where surface soil is at risk of loss. Erosion control projects ultimately establish a production base of forest resources by stabilizing ground soil and protecting soil resources, and promote the public benefits of forests through land conservation.

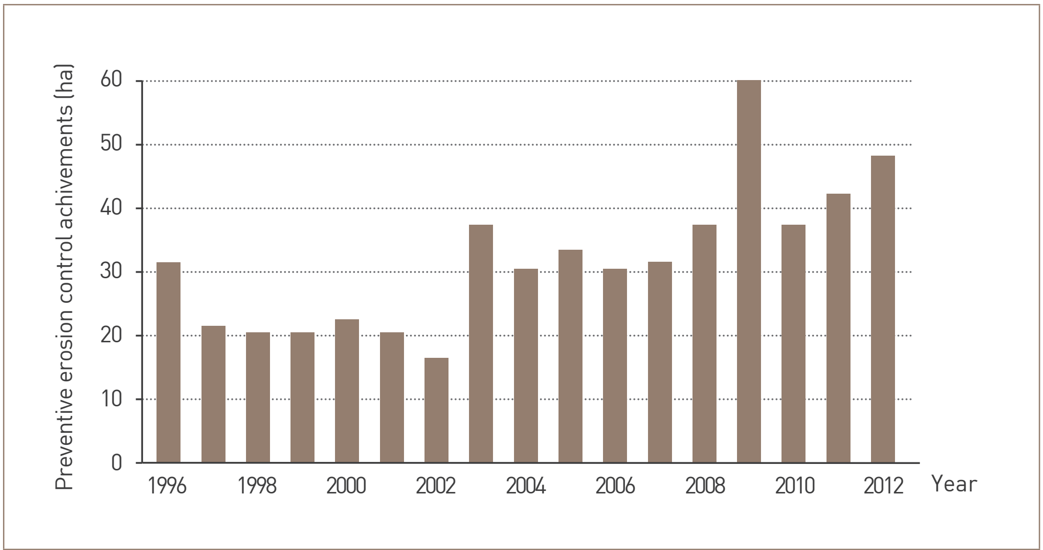
2) Data status and trend

The traditional erosion control project for soil protection is the hillside erosion control project. Since the preventive erosion control project was introduced in 1996, two types of erosion control projects are currently underway.

In 2012, the hillside erosion control project was conducted in the areas of 79 hectares. During the 1970s, minimum 5,000 hectares or more of the hillside erosion controls were annually performed. In the 1980s, the erosion control projects declined sharply because most of the devastated lands were restored into forests. Since the annual erosion control areas dropped under 100 hectares in 1996, it has stayed at an average of 86 hectares in the 2000s.

The preventive erosion control project aims to prevent or minimize damages from soil losses by controlling against landslides. The preventive erosion control projects were performed across 48 hectares in 2012, and have been on a steady increase since its introduction in 1996. It is further expected to increase as heavy rains due to climate change have been frequent and social awareness for safety concerns has grown.

[Figure 4-3] Achievements of the hillside erosion control



[Figure 4-4] Achievements of the preventive erosion control

Indicator 4-3 [MP 4.2.b] Area and proportion of forest land with soil degradation

1) Definition and importance

This indicator identifies the area and proportion of forests with degraded quality of soils. It includes (a) forest land areas with soil physical properties degraded by natural or human interferences such as forest fire, landslide or illegal deforestation, (b) the extent of degradation in soil chemical properties by soil disturbances and (c) changes in soil physiochemical properties which adversely affect soil fertility, cycle of nutrition and water and other ecological functions.

Good quality soil is composed of approximately 45% of mineral, 25% of air, 25% of water and 5% of organic compounds. Human interventions change the soil composition, resulting in degradation of plant growth. The stability and productivity of a forest is, in particular, closely related to the chemical properties of soil. Soil disturbances caused by indiscreet forest activities may deteriorate soil chemical properties.

This indicator presents the physiochemical property changes in soil through a long-term monitoring, enabling to predict what extent of soil degradation and how affects soil fertility and productivity of forest land.

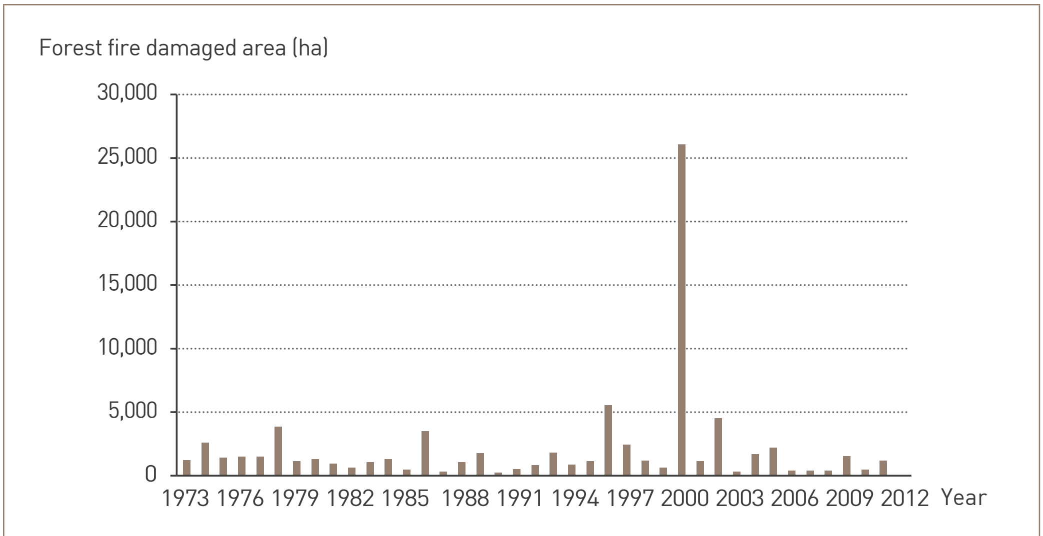
2) Data status and trend

The major factors which degrade and damage physical properties of forest soil are forest fires, illegal forest activities and landslides.

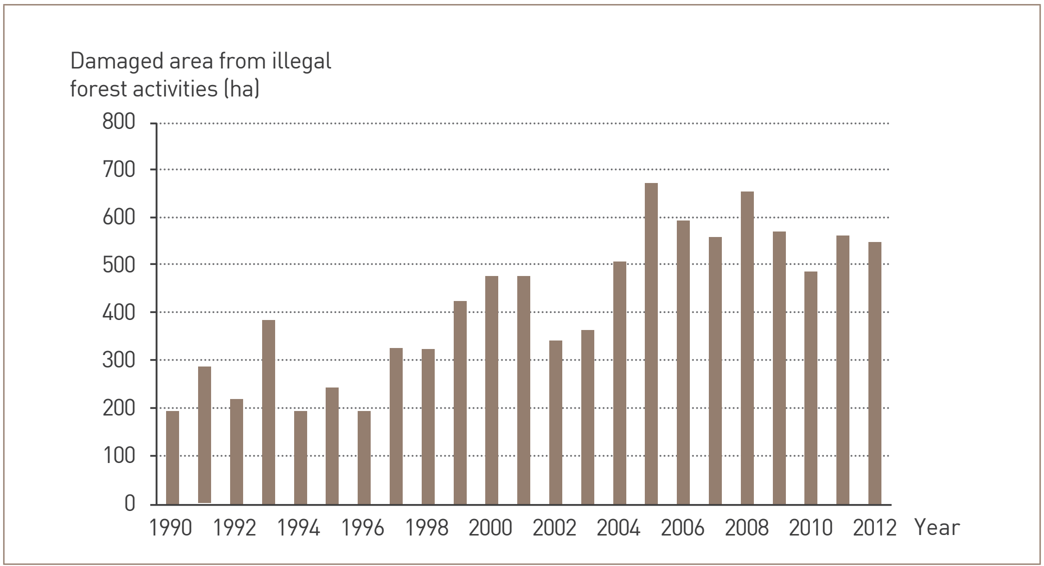
Forest fires degrade the physiochemical properties of soil by burning the organic compound layer of soil and removing its minerals, resulting in slowdown of vegetation growth and hardening the soil surface which makes it difficult for rain to infiltrate. Moreover, the removal of vegetation and litter layer causes a serious threat of soil loss from heavy rain and landslide. Damaged areas by forest fires significantly vary every year depending on weather conditions and causes of forest fires. The damaged area by forest fire in 2012 was 72 hectares, but the average damaged area per year was 733.9 hectares in the past ten years from 2003 to 2012.

Illegal deforestation such as unlicensed cutting of trees and illegal conversion of forest to other uses causes forest devastation and degrades the physiochemical properties of soil by excessive erosion and loss of nutrients in the exposed soil. According to a survey, forest damages from illegal activities are on a steady rise, reaching at 550 hectares in 2012, and on annual average 552.6 hectares of forests illegally destroyed in the past ten years from 2003 to 2012. The Korean government has taken strong measures to enforce penalties and patrols against illegal conversion of forests to other uses.

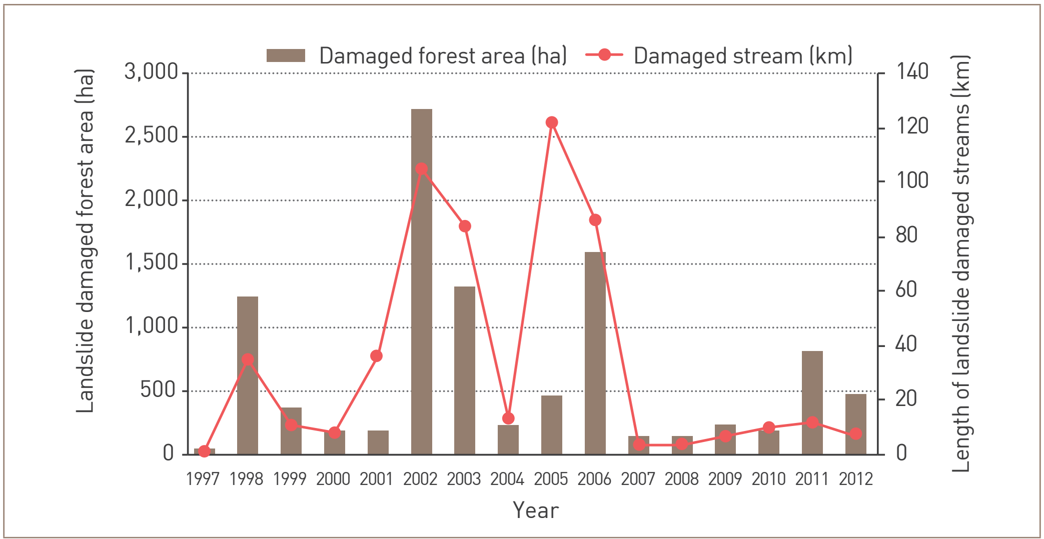
A massive soil collapse such as landslide completely destroys the physical structure of the surface soil, as well affects the torrent and downstream by debris flow. A landslide degrades the soil productivity and the torrent and downstream ecosystems and particularly causes a loss of human life and property. The reforestation efforts, started in the 1970s, successfully restored the barren mountains and subsequently reduced damages by soil losses. However, despite the national efforts to prevent soil erosion, frequent heavy rains due to climate change and indiscreet forest developments have caused a significant soil erosion, resulting in sharp increases of ecological and economic losses. In particular, in mountain slope areas the weakened grounds collapse and cause serious damages by releasing soil and rocks into the streams. In 2012 alone 491 hectares of forests and 7 kilometers of streams were damaged by landslides, and since 1997 the total damages have accumulated up to 10,000 hectares of forests and 540 kilometers of streams. The size of damages and the total damaged areas are gradually increasing due to frequent typhoons and heavy rains.



[Figure 4-5] Trend of damaged areas by forest fires



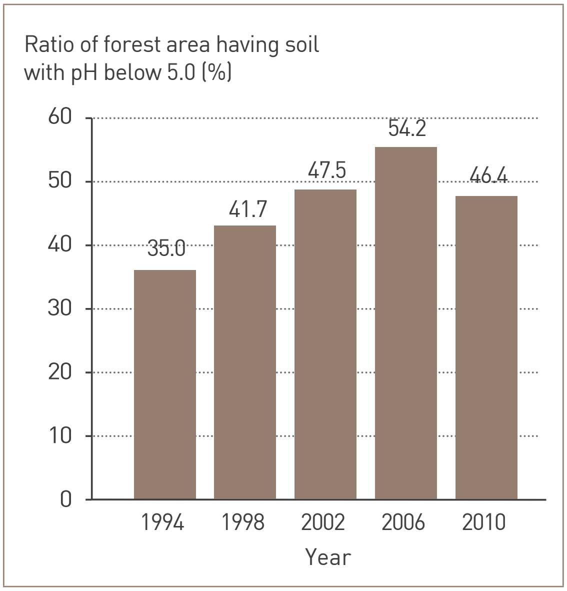
[Figure 4-6] Damaged area from illegal forest activities



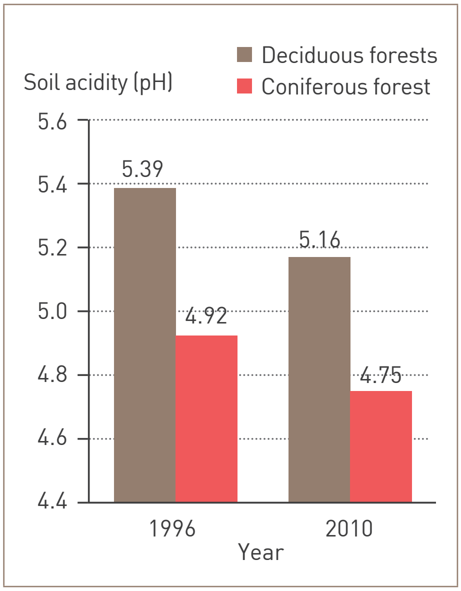
[Figure 4-7] Forest area and length of streams damaged by landslide

Soil acidification is one of indicators, indicating the chemical property changes of soil. Soil acidification implies a drop in acidity below pH 5.0, caused by air pollution and acidic rain. Once soil is acidified, it causes imbalance and deficiency of essential nutrients in soil for plants, inhibiting vegetation growth, and degrades soil chemical properties by hindering decomposition of litters.

The proportion of forests with a soil pH level of 5.0 or below was 35.0% in 1994, continued to increase to 54.2% by 2006, and slightly declined to 46.4% in 2010. In terms of forest type, coniferous forests tend to have a lower pH level than deciduous forests. In the past fifteen years, coniferous forests dropped from pH 4.92 to pH 4.75, while deciduous forests from pH 5.39 to pH 5.16.



[Figure 4-8] Proportion of forests with soil pH level at 5.0 or below



[Figure 4-9] Acidity changes in forest soil by forest type

Indicator 4-4 [MP 4.3.a] Forest management activities to protect water resources

1) Definition and importance

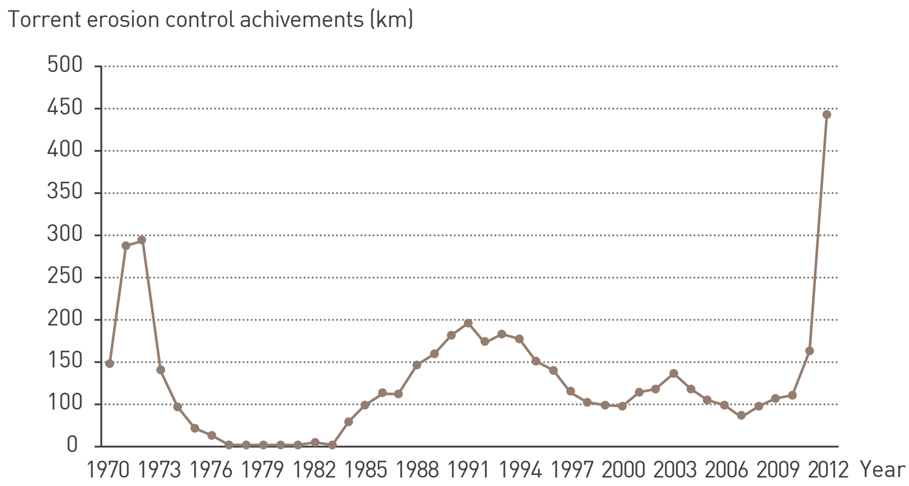
This indicator presents the area and proportion of forest management activities defined by best management practices or other relevant legislation to protect water resources. It includes the status and accomplishments of torrent erosion control and watershed management projects, as well as those of forest tending projects aimed at water retention and conservation. Torrent erosion control, watershed management and forest tending projects are the representative forest management activities to protect water resources by stabilizing soil in the stream, and to increase water quantity by improving a function of forests for water retention capability.

2) Data status and trend

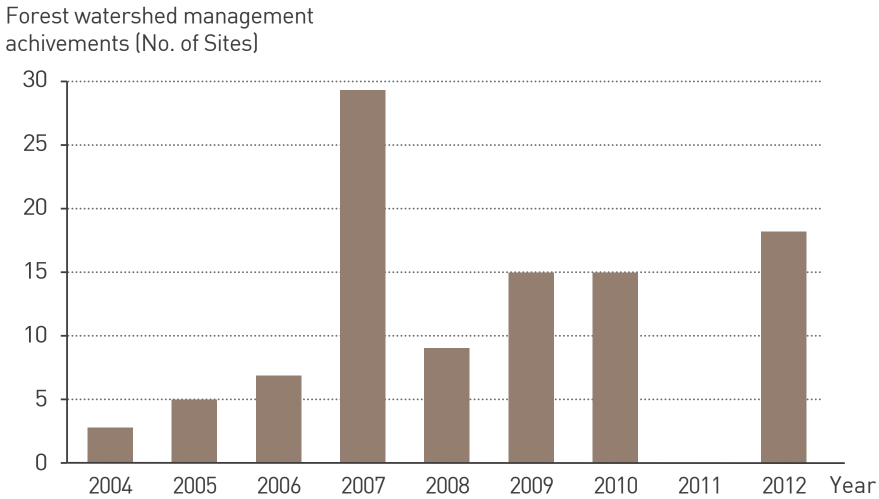
The torrent erosion control is a traditional measure for water resource protection, and the forest watershed management program was first introduced in 2004.

In 2012, torrent erosion control projects were implemented in a total of 439 kilometers. Torrent erosion control projects gained momentum in the early 1970s with active implementation of the hillside erosion control projects. In 1972 alone, 271km-long torrent erosion control projects were accomplished. Since then it sharply declined, and rose again after the mid 1980s. Especially, torrent erosion control projects are sharply increasing since the Mt. Woomyeonsan landslide in Seoul in 2011, accelerated with expansions of the construction of erosion control dams and the mountain stream conservation projects.

The forest watershed management program is a comprehensive project of integrating the entire forest watershed areas. It aims to maximize public and productive functions of forests by improving forest capacities for disaster prevention, water retention, water purification, forest resource increment and environmental conservation through implementing soil erosion control project, water management project, landscape management project and forest tending project. The projects were conducted most with 27 watershed areas in 2007, and with 18 watershed areas in 2012. This program is on a steady rise since its introduction.



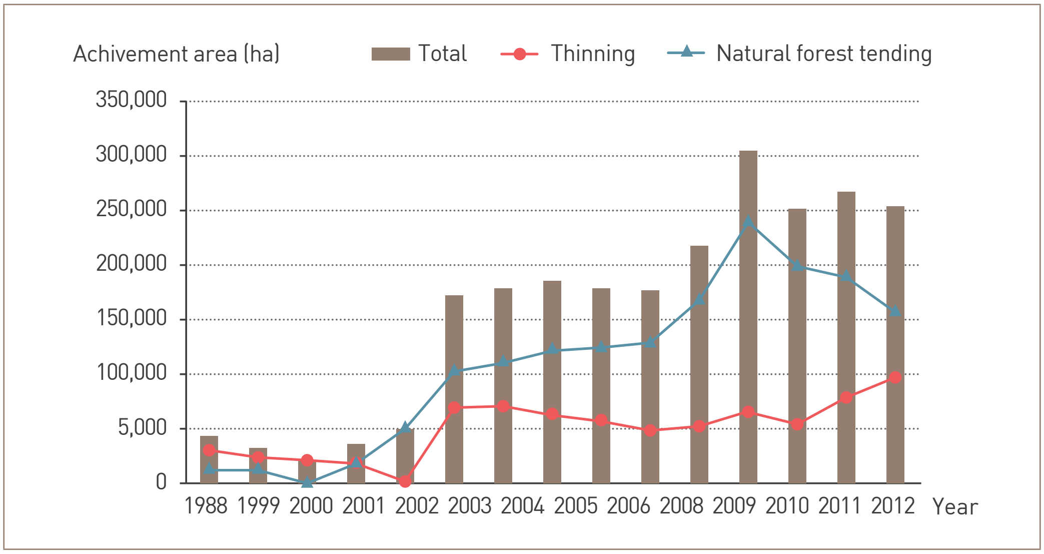
[Figure 4-10] Achievements of the torrent erosion control by year



[Figure 4-11] Achievements of forest watershed management projects

Forest tending practices such as thinning and pruning have positive effects on improving physical properties of soil and increasing its water retention capacity through promoting decomposition of organic matters in soil by exposing to more lights, especially in conifer forests, which induce the growth of herbaceous plants and lower vegetation. Forest tending program began in 1998 with the Forest Tending Public Works, and it was in a full-fledge after 2002. Forest tending projects include thinning, natural forest tending, young tree tending and vine removal. Among these, thinning and natural forest tending can be considered directly related to improving water resources.

The areas of forest tending projects, including thinning and natural forest tending, increased by more than 3.5 times, reaching 172,000 hectares, in 2003, compared to the previous year. In 2012 the area of both forest thinning and natural forest tending reached 253,000 hectares, which are thinning of 95,000 hectares and natural forest thinning of 158,000 hectares. Forest tending projects are expected to further expand not only to promote the public functions of forests such as watershed protection and biodiversity conservation but also to create economically viable forests.



[Figure 4-12] Achievements of forest tending practices

Criterion 5 Maintenance of forest contribution to global carbon cycles

Indicator 5-1 Total carbon stocks in forest biomass

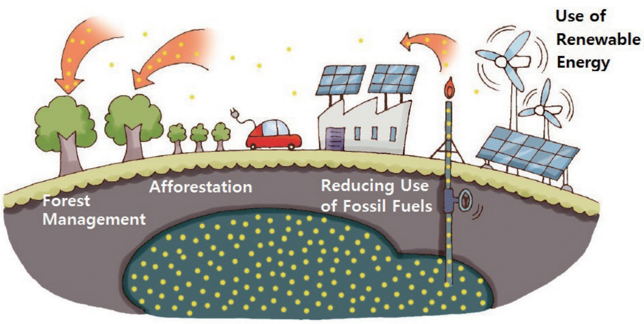
Indicator 5-2 Carbon budget of forest biomass

Maintenance of forest contribution to global carbon cycles

As the seriousness of global warming and climate change emerged due to the use of fossil fuels, the UN Framework Convention on Climate Change (UNFCCC) was adopted to save the planet and humankind from the threats posed by climate change at the United Nations Conference on Environment and Development (UNCED) summit held in Rio de Janeiro, Brazil in 1992. In addition, the Kyoto Protocol was adopted at the 3rd UNFCCC Conference of Parties (COP) in 1997 as a starting point driven by the efforts from the developed countries to reduce greenhouse gas (GHG) emissions. At the 17th COP in 2011 at Durban, South Africa, all countries agreed to reduce GHG emissions by 2020.

Korea has achieved a rapid growth in all areas of industry such as steel, petrochemical, power plant, machinery, shipbuilding and automobiles. This rapid industrial growth has put Korea on the 8th place in terms of the GHG emissions worldwide in 2010. Therefore it is projected that Korea will have an increasing burden of the GHG emission reduction. Nonetheless, the forests in Korea occupy 64% of the territory and serve as a carbon sink to absorb carbon dioxide in the air. It will contribute to reduction of GHG emissions.

KFS has enacted the Act on the Management and Improvement of Carbon Sink in 2012 in order to maintain and improve the carbon sink function of forests. By this Act, KFS has been operating the Forest Carbon Offset Program (FCOP). The FCOP is a system which certifies carbon removals from afforestation/reforestation, revegetation, forest management, reduced forest conversion and expansion of utilizing harvested wood products and forest biomass energy and allows parties transact them. Therefore, the positive contribution of forests to the global carbon cycle is expected to grow through vitalization of the FCOP.



[Figure 5-1] Mitigation Activities of GHG Emissions

Indicator 5-1 [MP 5.a] Total carbon stocks in forest biomass

1) Definition and importance

This indicator presents the total carbon stock stored in the Korean forest ecosystems. It includes all carbon deposits within the forest biomass, litters, dead woody debris and soil. Plants absorb carbon dioxide in the air to use for photosynthesis. Carbon becomes part of the plant body and returns to litters and soil, cycling within a ecosystem. Increasing the carbon sequestration of forests through forest management subsequently reduces the amount of carbon in the air and has an effect of maintaining a healthy forest ecosystem.

2) Data status and trend

As of 2010 the total carbon stock in the Korean forest biomass is 429,289 thousand tC, accounting for 33% by conifer forests, 35% by broadleaf forests and 32% by mixed forests. After the successful restoration of forests in the 1970s and 1980s, the carbon stock in the Korean forests is on a steady increase by about 10 billion tC per year. Nonetheless as the forests become mature, the increasing trend has slowed down recently.

In order to estimate the carbon stock, carbon emission factors are used to convert forest biomass into carbon equivalents. The 2009 national report applied the default factors provided by the Intergovernmental Panel on Climate Change (IPCC), but this report used the nationally developed factors which are unique for Korea. In other words, country-specific factors for the major tree species of Korea were developed, assessed and verified for uncertainty and certified as the national factors. The emission factors for a total of fifteen species, nine for conifer species and six for broadleaf species, have been recognized as national certified factors, and factors for other species are underway.

[Table 5-1] Carbon stocks in forest biomass in Korea

(Unit: 1,000 tC)

Year	Coniferous	Broadleaf	Mixed	Total
1990	52,433	44,498	45,637	142,569
1995	67,101	64,865	57,591	189,558
2000	86,429	91,210	87,485	265,124
2005	110,439	122,911	112,942	346,292
2010	139,577	151,126	138,586	429,289

Indicator 5-2 [MP 5.a] Carbon budget of forest biomass

1) Definition and importance

Forests absorb carbon from the atmosphere through growth of forest biomass, while releasing stored carbon into the air due to logging or forest fires. This indicator presents to what extent the amount of carbon in forests changes for a certain period of time. Korea estimates the carbon flux in forest biomass by using the changes in carbon stock of forest biomass.

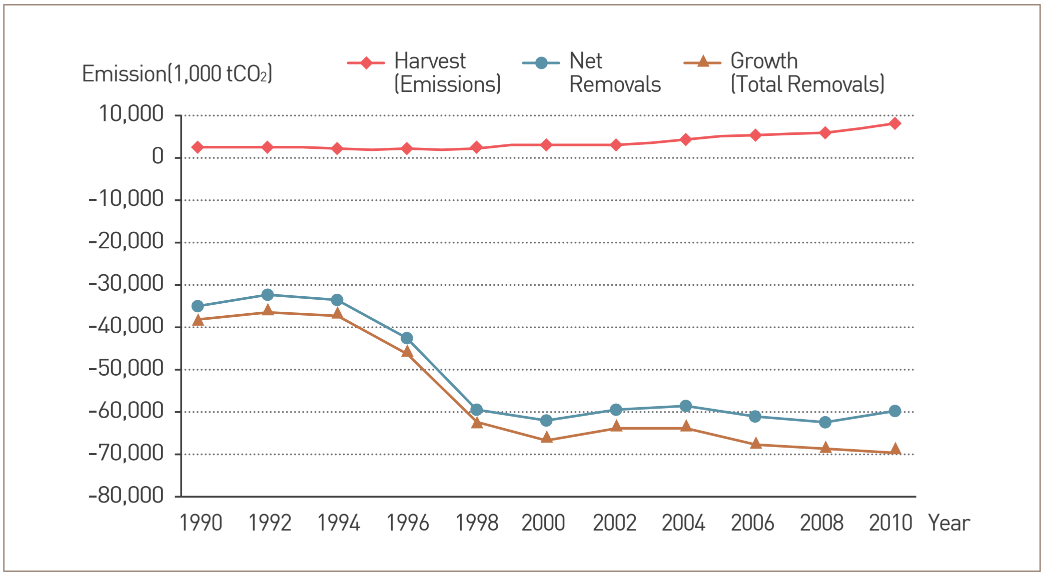
2) Data status and trend

As of 2010, the annual total removal of CO_2 from forest biomass growth was approximately 68,193 thousand tCO_2, whereas the corresponding emission from cutting was approximately 8,518 thousand tCO_2. Therefore, the annual net removal of CO_2 was estimated to be about 59,675 thousand tCO_2. Since 1999, the total CO_2 removals and emissions have remained at a relatively consistent level, and the net removals have been maintained at 60 million tCO_2.

[Table 5-2] Carbon budget of forest biomass in Korea

(Unit: 1,000 tCO_2)

Year	Total Removals	Net Removals	Emissions
1990	37,566	34,603	2,962
1995	39,894	37,524	2,371
2000	65,479	61,800	3,679
2005	65,345	60,001	5,344
2010	68,193	59,675	8,518



[Figure 5-2] Trend of the carbon budget of forest biomass in Korea

Criterion 6 Maintenance and enhancement of socioeconomic benefits of forests to meet the needs of societies

Maintenance and enhancement of socioeconomic benefits of forests to meet the needs of societies

A forest ecosystem is sustained in a healthy state when it can maintain reproducing capacity, ecological stability, biological components and adaptability to environmental change. However, forest ecosystems have been exposed to many threats from a rapid population growth and continuing development pressures over the past few decades. Large forest areas have been disturbed by human activities. This trend may continue as far as environmental and ecological stabilities of forest ecosystems are not considered. The functions that forests hold are very diverse. Historically forests have supplied multiple socioeconomic benefits needed for haman life.

Therefore, sustainable forest management implies a significant importance. By maintaining and improving forest ecosystems through the implementation of sustainable forest management, humans will receive the following socioeconomic goods and services in perpetuity:

- Biodiversity, excellent scenery, historical/religious/cultural values
- A variety of recreational opportunities such as eco-tourism, hiking and camping
- Genetic resources such as medicinal, edible and ornamental plants
- Production of basic necessities such as timber, fuel, food and medicinal plants
- Watershed conservation, air purification and wildlife protection
- Carbon fixation
- Land conservation by prevention of landslide and soil erosion

Abundant forest resources, labor and capital, as well as a variety of other intermediate products are needed to maintain and enhance such a variety of goods and services. Thus, socioeconomic benefits of forests are closely related to the level of investment.

Criterion 6 mainly focuses on economic and social sustainability, whereas the other criteria focus on the environmental sustainability. Criterion 6 of the Montreal process has five categories under it and each category holds a variety of indicators. However, this report includes only nine indicators that can be measured and reported in Korea.

These are Indicator <6-1> Value and quantity of wood and wood products, Indicator <6-2> Value and quantity of non-wood forest products, Indicator <6-3> Consumption of wood and wood products, Indicator <6-4> Consumption of non-wood forest products, Indicator <6-5> Employment and income in forestry sector, Indicator <6-6> GDP and forest sector GDP, Indicator <6-7> The mountain village experience programs: number of visitors and annual income, Indicator <6-8> Area and proportion of forests managed for public recreation and tourism and Indicator <6-9> Number of visitors by type of forest recreation.

Indicator 6-1 [MP 6.1.a] Value and quantity of wood and wood products

1) Definition and importance

This indicator measures the economic status and size of the Korean forest and timber industries by examining timber and wood products production. The production volume and value of timber and wood products provide the economic scale of forestry and timber industry, and incomes obtained here become an indicator that provides a return for forest management. They also play an important role of justifying formation, maintenance and management of forests. Decisions regarding production and harvest levels are influenced by the status of local economics, consumer value, effects of product trade on the economy and environment and the environmental effects of forest management.

2) Data status and trend

Domestic supply of roundwood increased slightly from 1,013 thousand m^3 in 1980 to 1,055 thousand m^3 in 1995. With the national financial crisis in 1997, the value of the Korean Won plunged sharply and wood shortages were supplemented with domestic supply of roundwood due to difficulties of importing timber from abroad. Since then, supply of domestic wood has increased greatly. Domestic fiberboard and pulp producers preferred domestic wood to ensure a steady supply of raw materials. It was also one of factors on increased domestic supply of wood. Supply of domestic roundwood increased to 1,350 thousand m^3 in 2005, to 3,715 thousand m^3 in 2010, and to 4,506 thousand m^3 in 2012.

[Table 6-1] Domestic supply of roundwood

(Unit: 1,000 m^3)

Year	1980	1985	1990	1995	2000	2005	2010	2011	2012
Quantity	1,013	1,236	1,138	1,055	1,592	2,350	3,715	4,210	4,506

Korea began its first fiberboard production in 1984. In the early 1990s, increased production of fiberboard (MDF) activated domestic supply of softwood timber, such as *Pinus rigida*, the main raw material for MDF. In addition, softwood timber production increased faster with acceleration of thinning practices in the forests propelled by the national forest tending projects, pursued for creation of jobs after the financial crisis in 1997. MDF production was at 931 thousand m^3 in 2000 and reached its peak at 1,836 thousand m^3 in 2010, and slightly declined to 1,712 thousand m^3 in 2012.

[Table 6-2] **Fiberboard (MDF) production volume**

(Unit: 1,000 m^3)

Year	1986	1990	1995	2000	2005	2010	2011	2012
Quantity	11	113	590	931	1,653	1,836	1,812	1,712

Plywood industry in Korea has emerged as the world's number one exporter, leading the Korean industrialization era as one of the most important export industries in the 1960s and 1970s. In the 1970s, more than 70% of the production was exported overseas.

However, Southeast Asian countries, including Indonesia, started regulating hardwood law timber exports in the 1980s and it became difficult to obtain a raw material to produce plywood. In the 1990s, the raw materials changed to softwood and facilities became automated. After the 2000s, the emergence of China's plywood industry and its low-price exports brought a negative impact on the Korean plywood industry. Korea's plywood industry could not escape the recession caused by these processes.

Korea's plywood production volume, which was at 1,575 thousand m^3 in 1980, decreased to 680 thousand m^3 in 2005, to 450 thousand m^3 in 2010, and to 435 thousand m^3 in 2012.

[Table 6-3] **Plywood production volume**

(Unit: 1,000 m^3)

Year	1980	1985	1990	1995	2000	2005	2010	2011	2012
Quantity	1,575	1,227	1,124	974	747	680	450	455	435

The Korean particle board industry began in 1960 using only its own technology, without any acquisition of equipments from abroad. Particle board production has steadily grown from the early 1970s to the early 1990s due to the furniture demand.

Particle boards are mainly produced using recycled woods as a raw material such as lumber by-products, construction waste wood and life waste wood. However, domestic roundwood has been used due to the shortage of recycled woods in recent years. As a result, domestic particle board production has been stagnant due to the difficulties of obtaining raw materials, rising production costs and price competition with imported goods.

Particle board production began to increase in the mid 1980s, reached 700 thousand m^3 in 1997 and decreased slightly due to the financial crisis in 1998, but showed the increase again after 2000. Particle board production volume, reached at 847 thousand m^3 in 2005 and at 919 thousand m^3 in 2010, decreased to 795 thousand m^3 in 2011 and to 801 thousand m^3 in 2012.

[Table 6-4] **Particle board production volume**

(Unit: 1,000 m^3)

Year	1980	1985	1990	1995	2000	2005	2010	2011	2012
Quantity	68	55	165	548	722	847	919	795	801

Korean pulp production has been increasing annually. Pulp production was 167 thousand M/T in 1980 and reached 562 thousand M/T in 2012, which was a 3.4-fold increase during the same period.

Most of the pulp currently produced in Korea is chemical pulp. Mechanical pulp is mainly used for newsprint, but has been replaced by recycled paper, resulting in reduction of mechanical pulp production. Mechanical pulp production has been stagnant due to the difficulty with raw material supply.

Pulp production volume was 562 thousand M/T in 2012. Among this, chemical pulp

[Table 6-5] **Pulp production volume**

(Unit: 1,000 M/T)

Year	1980	1985	1990	1995	2000	2005	2010	2011	2012
Total	167,097	267,661	301,311	500,597	594,442	511,797	511,333	585,108	562,270
Chemical pulp	29,656	129,217	141,922	319,385	418,818	411,467	402,067	447,048	449,804
Mechanical pulp	137,441	138,444	159,389	181,212	175,624	100,330	109,266	138,060	112,466

comprised 450 thousand M/T and ground wood pulp 112 thousand M/T, accounting for 80% and 20% of the total production, respectively.

Paper production in Korea was 2,607 thousand M/T in 1985 and increased to 5,105 thousand M/T in 1990, which was about 2 times increase. Paper production exceeded 10 million M/T in 2000, and reached 11,322 thousand M/T in 2012. It was a decrease by 158 thousand M/T, compared to 2011.

Container board production was at 4,037 thousand M/T, accounting for 36% of the total paper production volume, which was the largest, followed by printing and writing paper of 28% with 3,207 thousand M/T and newsprint of 13% with 1,523 thousand M/T.

[Table 6-6] Trend of paper production

(Unit: 1,000 M/T)

Year	1985	1990	1995	2000	2005	2010	2011	2012
Total	2,607	5,105	7,802	10,250	11,820	11,106	11,480	11,322
News print	239	522	948	1,770	1,588	1,556	1,538	1,523
Printing & Writing paper	602	1,160	1,848	2,434	3,043	3,030	3,278	3,207
Boxboard	314	682	943	1,263	1,194	1,294	1,348	1,418
Container board	712	1,384	2,122	2,775	3,586	4,084	4,157	4,037
Other papers	740	1,357	1,941	2,008	2,409	1,142	2,507	1,137

Indicator 6-2
[MP 6.1.b]

Value and quantity of non-wood forest products

1) Definition and importance

This indicator shows production trends in quantity and value of non-wood forest products. A variety of non-wood products are produced in Korea but only the major non-wood products available for quantitative analysis on quantity and value are illustrated. Even though the profitability of wood production is very low in Korea, production of non-wood products significantly contribute to raising the income of local communities by supplementing the low profitability of wood production. Especially, non-wood products such as nuts and fruits, wild vegetables, mushrooms, medicinal plants and saps are supplied as a safe and healthy food.

2) Data status and trend

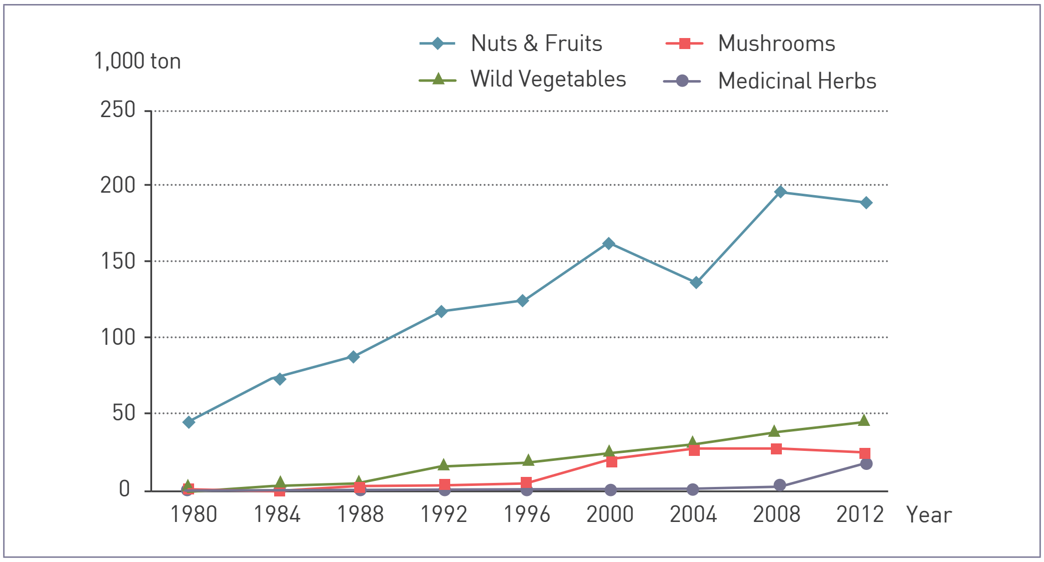
As of 2012, the gross forest production was 423.9 billion Won, and non-wood products production occupied 388.1 billion Won, accounting for 91.6% of the gross production. The non-wood products production shares the most of the gross forest production, and is continuing to increase.

Among them are the nuts and fruits accounting for the highest proportion of non-wood products in Korea. The major nuts and fruits include chestnuts, pine nuts, jujubes, walnuts, bitter persimmons, gingko nuts and acorns. The production quantity of nuts and fruits has sharply increased from 45.5 thousand tons in 1980 to 95.8 thousand tons in 1990 and to 161.3 thousand tons in 2000. However, the production volumes started to decrease in 2001 and lowered to 109.6 thousand tons in 2003, but sharply increased to 206.4 thousand tons in 2010. The volume was 189.4 thousand tons in 2012. The production value of the nuts and fruits was 45.9 billion Won in 1980, increased significantly in 1990 to 150.4 billion Won and to 391.3 billion Won in 2000 and reached 761.9 billion Won in 2012.

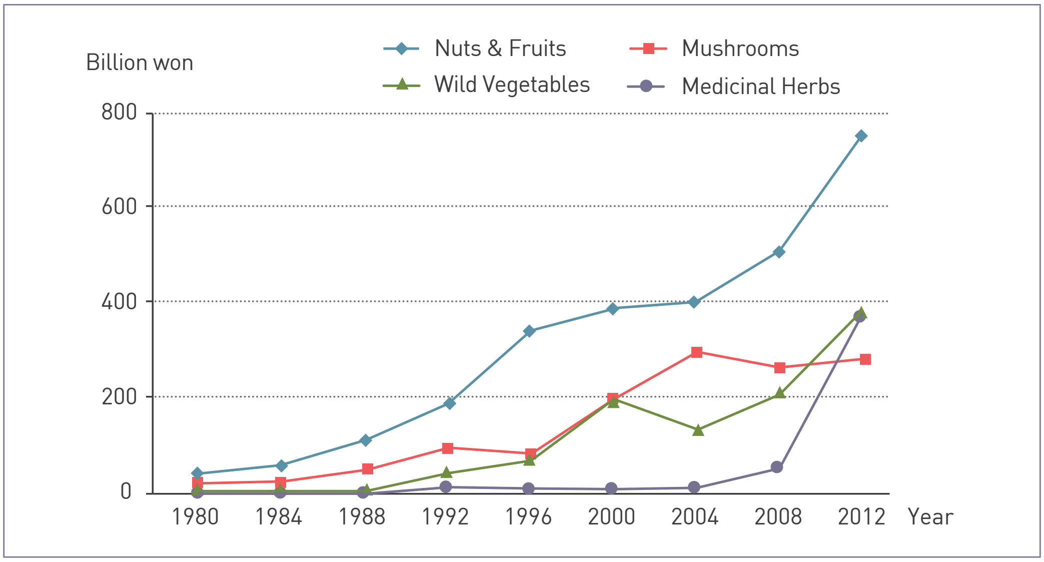
Mushrooms are an important non-wood product in Korea, and include *Lentinula edodes* (oak mushroom), *Tricholoma matsutake* (pine mushroom), *Auricularia auricula-judae* (tree-ear), *Umbilicaria esculenta* (manna lichen), *Pleurotus ostreatus* (common oyster mushroom), *Sarcodon aspratus*, and *Ramaria botrytis* (red-tipped ciavaria). Mushroom production was at 1,500 tons in 1980 and 3,000 tons in 1990. The production quantity reached 20.7 thousand tons in 2000 and 26.3 thousand tons in 2012 with the technological development of mushroom cultivation. The production value of mushrooms has been steadily increasing from 16.4 billion Won in 1980 to 64.4 billion Won in 1990, to 201 billion Won in 2000, to 298.3 billion Won in 2010, and to 287.1 billion Won in 2012.

Wild vegetables, along with nuts and fruits and mushrooms, are another non-wood product accounting for a significant proportion of the total non-wood products, and include *Pteridium aquilinum* var. *latiusculum* (bracken), *Platycodon grandiflorum* (balloon flower), *Codonopsis lanceolata* (deodeok), *Aralia elata* (Japanese angelica), *Aster scaber* (chwinamul) and *Osmunda japonica*. Production quantities were merely at around 1,500 tons in 1980, increased sharply in the late 1980s, and reached 25.6 thousand tons in 2000 and 46.0 thousand tons in 2012. Wild vegetable production has been increasing steadily with the public recognition as a healthy food. The production value of wild vegetables increased from 900 million Won in 1980 to 25.3 billion Won in 1990, and recorded a sharp increase to 200.5 billion Won in 2000. However, the production dropped to 144.8 billion Won in 2004 with reduced consumption, but regained to reach 388.6 billion Won in 2012.

Medicinal plants occupy a relatively smaller portion of production compared to other non-wood products, but increased from 1,100 tons in 1980 to 1,800 in 1993. The production volume began to decrease and was 1,200 tons in 2000. With increasing interest on healthy herbs, the production volume increased sharply to 20.7 thousand tons in 2009, and stayed at 18.7 thousand tons in 2012. The value of medicinal herbs production has increased steadily from 1.6 billion Won in 1989 to 10.4 billion Won in 1990 and to 11.5 billion Won in 2000. The figure increased sharply to 541 billion Won in 2011 and decreased to 384.5 billion Won in 2012.



[Figure 6-1] **Production quantity of non-wood products**



[Figure 6-2] **Production value of non-wood products**

Indicator 6-3 [MP 6.1.d] Consumption of wood and wood products

1) Definition and importance

This indicator shows whether supply of wood and wood products satisfies domestic consumption needs. As consumption needs for wood products are a reaction to diverse factors such as price of wood products, prices of substitutes, environmental value, recycling potential and income levels, it is a indicator showing overall preferences of the people on wood products. The status of supply structure and domestic supply for wood consumption in Korea can also be identified from this indicator.

2) Data status and trend

Wood is a renewable eco-friendly material. Wood consumption in Korea has steadily increased over the past several decades by the impacts of economic and industrial development.

Wood consumption in Korea increased from 21,746 thousand m^3 in 1990 to 27,970 thousand m^3 in 2000, and remained at 27,607 thousand m^3 in 2012. The self-sufficiency

[Table 6-7] Consumption of wood and wood products

(Unit: 1,000 m^3, 1,000 persons)

Year	Consumption of wood products				Estimated population	Per capita wood consumption (m^3)
	Sum	Domestic roundwood	Imported roundwood	Imported wood products		
1990	21,746	1,138	8,285	12,323	42,869	0.51
1995	24,390	1,196	7,800	15,394	45,093	0.54
2000	27,970	1,592	6,735	19,643	47,008	0.60
2005	26,719	2,350	6,022	18,347	48,138	0.56
2010	27,612	3,715	4,227	19,670	49,410	0.56
2011	27,484	4,210	4,030	19,244	49,779	0.55
2012	27,607	4,506	3,686	19,627	50,004	0.55

of wood supply in Korea is very low with only at 15% in 2012. Because most forests are yet young and premature for final cutting, the majority of domestic timber demand relies on imported wood and wood products.

Per capita wood consumption increased from 0.51 m^3 in 1990 to 0.60 m^3 in 2000, and slightly reduced to 0.55 m^3 in 2012. However, the total consumption of wood and wood products is expected to grow due to the rising living standards and concerns on the improvement of residential conditions.

Roundwood consumption in Korea increased from 7,154 thousand m^3 in 1980 to 9,423 thousand m^3 in 1990 and to 9,284 thousand m^3 in 1995. Roundwood consumption in 2012 was 8,192 thousand m^3, of which the domestic roundwood was 4,506 thousand m^3, amounting to 55% of the total roundwood consumption.

The roundwood consumption in Korea was mainly for plywood production sourced from imported tropical hardwood until the mid 1990s. From the end of the 1990s plywood production relied on imported timber decreased, while fiberboard production expanded. Accordingly the roundwood consumption pattern changed to fiberboard production. Recently domestic timber is mainly used for fiberboard and pulp productions, whereas imported timber for lumber production.

[Table 6-8] Consumption of roundwood

(Unit: 1,000 m^3)

Year	Domestic		Imports (B)	Exports (C)	Domestic consumption (D)
	Production	Shipments(A)			
1980	933	1,013	6,141	0	7,154
1985	781	1,236	5,578	0	6,814
1990	923	1,138	8,285	0	9,423
1995	735	1,055	8,229	0	9,284
2000	1,038	1,592	6,735	1	8,327
2005	1,826	2,350	6,221	0	8,571
2010	3,726	3,715	4,227	0	7,942
2011	3,957	4,210	4,030	0	8,240
2012	4,654	4,506	3,686	0	8,192

※Note: Consumption (D) = Shipment (A) + Imports (B) – Exports (C)

Particle board had been mainly used for furnitures, especially for kitchen furnitures. Lately the end uses of particle board became more diverse from home furnitures to office supplies.

Particle board consumption in Korea has steadily grown since 1980. It increased from 23 thousand m^3 in 1980, to 1,013 thousand m^3 in 1995 and to 1,701 thousand m^3 in 2010. Recent consumption of particle board showed a slight decline from 1,588 thousand m^3 in 2011 to 1,513 thousand m^3 in 2012. However, domestic consumption of particle board is expected to increase due to its diverse uses.

[Table 6-9] **Consumption of particle board**

(Unit: 1,000 m^3)

Year	Domestic		Imports (B)	Exports (C)	Domestic consumption (D)
	Production	Shipments(A)			
1980	68	48	3	28	23
1985	55	54	58	0	112
1990	165	165	460	0	625
1995	548	547	485	19	1,013
2000	722	718	485	4	1,199
2005	847	872	759	2	1,629
2010	919	899	805	3	1,701
2011	795	817	772	1	1,588
2012	801	772	743	2	1,513

※Note: Consumption (D) = Shipments (A) + Imports (B) – Exports (C)

Fiberboard (MDF) consumption increased from 34 thousand m^3 in 1985 to 1,064 thousand m^3 in 2000, and to 1,957 thousand m^3 in 2010. Nonetheless, it decreased for consecutive 2 years to 1,810 thousand m^3 in 2011 and to 1,615 thousand m^3 in 2012. The main cause of reduced consumption of fiberboard appears to be from the recent recession of domestic construction businesses.

Fiberboard is mainly used for furniture, flooring and building interiors, and also goes to the electronics and automotive industries.

[Table 6-10] Consumption of fiberboard (MDF)

(Unit: 1,000 m^3)

Year	Domestic		Imports (B)	Exports (C)	Domestic consumption (D)
	Production	Shipments(A)			
1980	-	-	0	0	0
1985	11	11	23	0	34
1990	113	113	82	7	188
1995	590	543	76	19	600
2000	931	783	380	99	1,064
2005	1,653	1,580	416	48	1,948
2010	1,836	1,751	226	20	1,957
2011	1,812	1,746	124	60	1,810
2012	1,712	1,593	127	105	1,615

※Note: Consumption (D) = Shipments (A) + Imports (B) – Exports (C)

Plywood is mainly used for building interiors and furniture materials. Plywood consumption increased from 908 thousand m^3 in 1985 to 1,990 thousand m^3 in 1995.

[Table 6-11] Consumption of plywood

(Unit: 1,000 m^3)

Year	Domestic		Imports (B)	Exports (C)	Domestic consumption (D)
	Production	Shipments(A)			
1980	1,575	668	23	953	691
1985	1,227	1,024	11	127	908
1990	1,124	1,011	735	76	1,670
1995	974	787	1,307	104	1,990
2000	747	619	980	93	1,506
2005	680	674	1,242	15	1,901
2010	450	463	1,251	6	1,708
2011	455	438	1,138	7	1,569
2012	435	417	1,212	4	1,625

※Note: Consumption (D) = Shipments (A) + Imports (B) – Exports (C)

However, plywood consumption was significantly reduced as plywood for building interiors and furniture was replaced by fiberboard and particle board from the late 1980s. Plywood consumption reached 1,901 thousand m^3 in 2005, but decreased to 1,569 thousand m^3 in 2011 and to 1,625 thousand m^3 in 2012, indicating an overall decline since then.

In contrast, pulp consumption in Korea increased from 639 thousand M/T in 1980 to 3,006 thousand M/T in 2005, which was a 5-fold increase during that period. Since then, it remained at an annual consumption of about 3 million M/T.

Most of the pulp consumption in Korea comes from chemical pulp. The proportion of chemical pulp out of the total pulp consumption was 64% in 1970, sharply increased to 97% in 2005, and reduced to 85% in 2012.

[Table 6-12] Consumption of pulp

(Unit: 1,000 M/T)

Year	Domestic production (A)	Imports (B)	Exports (C)	consumption (D)
1980	167	472	0	639
1985	268	570	0	838
1990	301	1,168	0	1,459
1995	501	1,912	18	2,395
2000	594	2,137	0	2,731
2005	512	2,494	0	3,006
2010	511	2,517	81	2,947
2011	585	2,493	31	3,047
2012	562	2,373	12	2,923

※Note: Consumption (D) = Shipments (A) + Imports (B) – Exports (C)

Indicator 6-4 [MP 6.1.e] Consumption of non-wood forest products

1) Definition and importance

This indicator provides information on the consumption of non-wood forest products. The quantity of non-wood products consumed illustrates the consumer preference for the forest products.

2) Data status and trend

Demand for non-wood products has sharply increased with increasing concerns on healthy foods under the influences of economic development and urbanization. Particularly, development of non-wood product cultivation techniques has been supporting such increases in consumption.

The consumption trends were examined for the major non-wood products such as chestnut, pine nut, jujube, walnut and oak mushroom. Consumption of chestnuts had been steadily increasing since 1980 along with the increase of its production. Especially in 1997 the chestnut production reached its peak at 129.7 thousand tons, but largely reduced to 62.3 thousand tons in 2012. It appeared to be the result of reduction in chestnut cultivation areas.

Meanwhile the export of chestnut increased along with its high production, and in 1988 half of the production was shipped to Japan and the US. Since then the level of export dwindled. Even after 2000 the import of chestnuts from China gradually increased, and in 2012 the export quantity of 12.2 thousand tons was exceeded by the import volume of 12.9 thousand tons.

Chestnut consumption had continually increased up to 103.5 thousand tons in 1997 from 50.2 thousand tons in 1980. However, after 1998 chestnut consumption decreased along with the decline of its production. Since 2003 the chestnut production stayed stagnant with the increasing import from China and the decreasing export, and the level of chestnut consumption has been almost same as the level of its domestic production. As of 2012 chestnut consumption remained at 63.1 thousand tons.

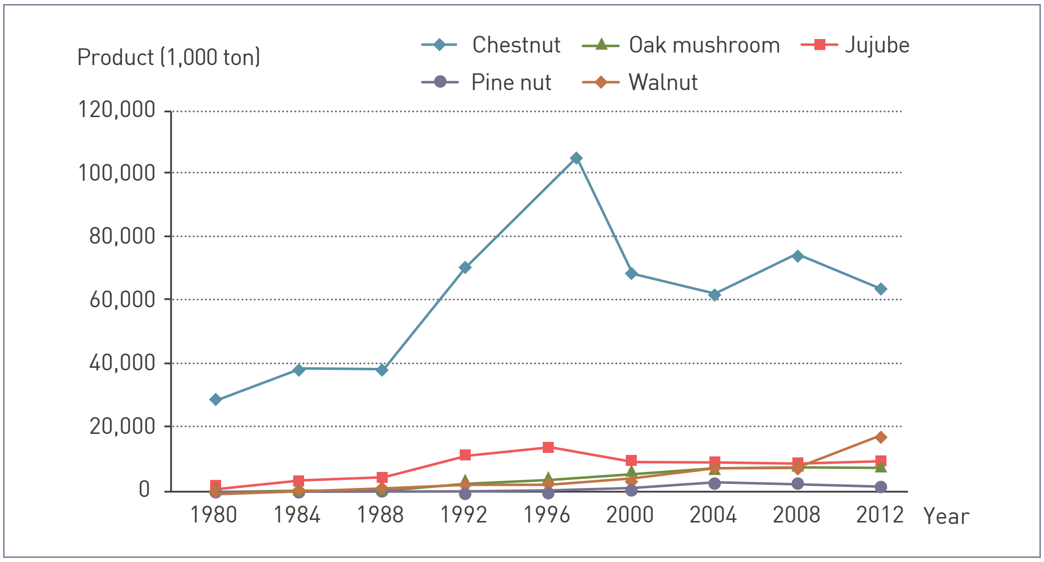
Pine nuts have been mainly consumed during the main holiday seasons such as

Chuseok (Korean Thanksgiving Day) and Seol (lunar new year's day). As pine nut was recognized as a healthy food, its consumption began to increase from 2003. Pine nut production was at 2,263 tons in 2003, much higher than an annual average production of 825 tons in previous years. Especially it increased to 6,720 tons in 2010, but dropped to 1,548 tons in 2012, merely a quarter, compared to 2010. Pine nuts are more imported than exported. After 2010 less than 100 tons of pine nuts are imported, mainly frozen nuts from China. In the past, pine nut consumption increased 6 times from 531 tons in 1980 to 3,200 tons in 2004. Since then the consumption level kept fluctuating, and rose sharply up to 6,700 tons in 2010 along with the increase of its production. However, as pine nut production plummeted and its trade stayed at a low level in 2012, pine nut consumption remained at approximately 1,600 tons, which was similar to its production level.

Both consumption and production of jujube increased sharply as improved breeds began to spread. Jujube consumption reached its peak at 14,113 toms in 1996 from 641 tons in 1980. Jujube production reduced to 6,645 tons in 2003 from its peak at 13,969 tons in 1996. At the end of 2012, jujube production was at 9,509 tons, slightly above the average of the past decade. Jujube is exported to the US in a small amount, while the import mostly comes from China with an annual average of 370 tons from 1995 to 2008. The recent annual average consumption of jujube was about 9,400 tons, slightly above its production level. Nonetheless, with the increased import of jujube from China, the consumption of jujube also increased to 9,665 tons as of 2012.

Walnut consumption was stable until the end of the 1980s. With the increased import of peeled walnuts from the US in the early 1990s, its consumption level has significantly increased from 1992. The domestic walnut production is merely 1,000 tons a year, a small fraction of which is exported to the US. Therefore most of the walnut consumption relies on the import. Walnut consumption increased from 2,128 tons in 1992 to 5,278 tons in 1994 and to 12,464 tons in 2006. Since then, with the sharp increase of its import from US, walnut consumption reached at 17,455 tons as of 2012.

The consumption of oak mushrooms has shown a steady growth since 1980. Oak mushrooms are cultivated in oak logs. Its production amount increased from 1,034 tons in 1986 to 6,185 tons in 2009, and declined to 4,367 tons in 2012. Some of oak mushrooms are imported from China, amounting to 1,372 tons in 1997 and to 3,494 tons in 2012. The most of imported oak mushrooms are processed ones rather than fresh or dried ones. Meanwhile the dried oak mushrooms exported to Taiwan and Hong Kong, amounting to 683 tons in 1980 and its peak at 1,083 tons in 1987, but down to a mere 143 tons in 2012. The consumption level showed significant increases from 344 tons in 1980 to 974 tons in 1990, to 5,909 tons in 2000, to 7,676 tons in 2005, and to 8,631 tons in 2010, but a slight reduction to 7,718 tons in 2012.



[Figure 6-3] Consumption of non-wood products

Indicator 6-5 [MP 6.3.a, 6.3.b] Employment and income in forestry sector

1) Definition and importance

Employment in the forestry sector requires a broad range of expertise. It includes tree seed collection, seedling production, reforestation, forest tending, forest pests and diseases control, erosion control and forest road buildings, forest fire prevention and control, timber production, forest products production, distribution and processing and supply of forestry-related services.

Forestry labor work enriches forest resources, promotes the economic and public values of forests, and provides many benefits that enhance the quality of life for citizens.

Employment in forestry has contributed to job creation such as many public work projects in the forests since the economic crisis of 1997. As national policies put an emphasis on the quality of employment, forestry sector also requires much effort in improving working and employment conditions.

2) Data status and trend

In regards to forest work labor that is a representative forestry labor, forest employers by the type of forest ownership organize and operate so-called the forest work group (a forest worker unit) to provide a stable forest labor supply. There are the national forest work groups working in the national forests, private forest work groups working in the private forests and the forest work units in the forest corporate bodies.

Per capita average annual days of employment of workers in the national forest work groups decreased by 8 days from 187 days in 2011 to 179 days in 2012, and per capita average monthly days of employment of workers were 14.9 days in 2012. Meanwhile, per capita average annual days of employment of workers in the private forest work groups decreased by 5 days from 134 days in 2011 to 129 days in 2012, and per capita average monthly days of employment of workers were 10.8 days in 2012.

Per capita average annual income of workers in the national forest work groups increased by 5,125 thousand Won from 35,646 thousand Won in 2011 to 40,771 thousand Won in 2012. Meanwhile, per capita average annual income of workers for the private forest work groups decreased by 536 thousand Won from 29,542 thousand Won in 2011 to 29,006 thousand Won in 2012. The reasons for the reductions in the working days and incomes of workers in the forest work groups lie in the reduction in subsidized forest projects by the central and local governments.

[Table 6-13] Employment and income of workers in the forest work groups

Year	Annual labor days (days per capita, per year)		Annual average income (1,000 Won per capita, per year)	
	National forest	Private forest	National forest	Private forest
2005	235	150	20,815	15,939
2007	211	169	21,350	13,610
2008	232	167	25,282	20,228
2009	229	170	28,766	27,656
2010	188	157	30,322	29,908
2011	187	134	35,646	29,542
2012	179	129	40,771	29,006

[Table 6-14] Employment and income of workers in wood-related manufacturing sector

(Unit: million Won)

Year	Wood and wood-related manufacturing sector (C16)				Pulp, paper and paper-related manufacturing sector (C17)			
	Number of Businesses	Number of Employees	Total annual wage	Annual wage per capita	Number of Businesses	Number of Employees	Total annual wage	Annual wage per capita
1995	2,490	40,510	447,587	11.0	2,671	69,129	885,549	12.8
1996	2,392	37,377	470,210	12.6	2,713	67,187	957,960	14.3
1997	2,056	31,180	418,310	13.4	2,639	62,578	969,185	15.5
2010	788	17,257	445,467	25.8	1,545	51,206	1,509,278	29.5
2011	767	17,421	464,035	26.6	1,520	50,235	1,574,076	31.3
2012	770	17,011	470,604	27.7	1,584	51,882	1,688,806	32.6

※Source: 2012 Mining and Manufacturing Survey Report (companies with 10 employees or more),
1997 Statistics and Research Report on Mining and Manufacturing sector (companies with 5 employees or more).

Per capita average annual income of the workers in the wood and wood products manufacturing sector (C16) increased by 1.1 million Won from 26.6 million Won in 2011 to 27.7 million Won in 2012. Per capita average annual income of the workers in the paper and paper products manufacturing sector (C17) increased by 1.3 million Won from 31.3 million Won in 2011 to 32.6 million Won in 2012.

Indicator 6-6 [MP 6.3.a, 6.3.b] GDP and forest sector GDP

1) Definition and importance

Gross Domestic Product (GDP) refers to the index representing production capacities as the total values generated for a certain period of time in the country, whereas the Gross National Income (GNI) is an index representing the purchasing power of the country; that is, the sum of the income received in exchange for participating in productive activities at home and abroad.

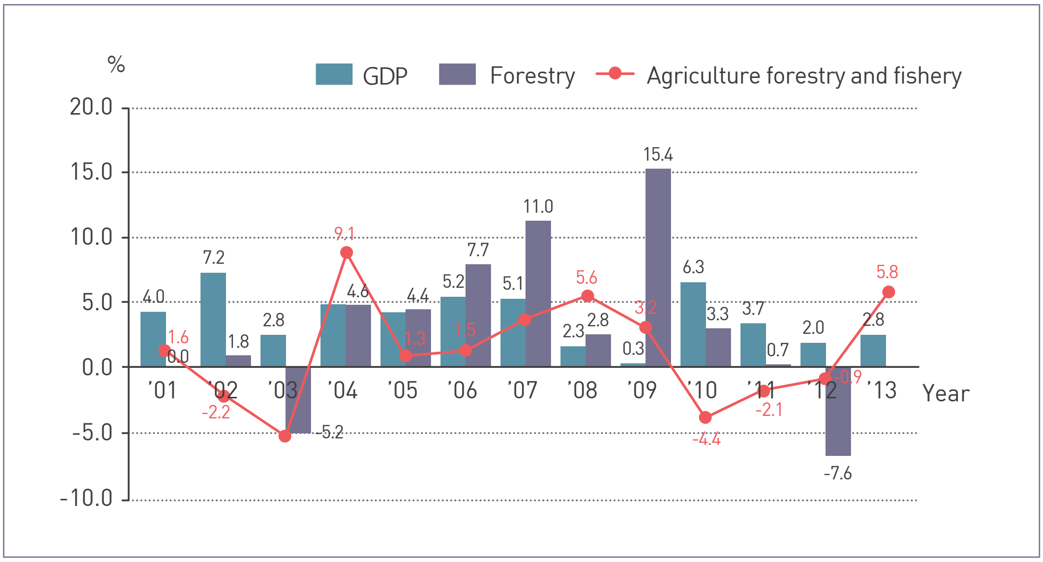
GDP in the forestry sector is calculated and provided separately between the forestry sector and wood-related manufacturing sectors where goods and services are produced utilizing wood as a raw material. The manufacturing sectors belonging to the forestry sector are classified into the wood and wood products manufacturing sector, the furniture and other products manufacturing sector and the pulp and paper products manufacturing sector.

GDPs of the forestry and the forest industry sector using wood as a raw material have been growing quantitatively each year, but the contribution of these sectors all together to the national economy remains at a merely 1% level of the total GDP.

2) Data status and trend

Korea's real GDP of 2012, adjusted for inflation with respect to 2005, was 1,104 trillion Won, increased by 22 trillion Won from 1,082 trillion Won in 2011, showing a 2.0% growth. Meanwhile, the real forestry GDP in 2012 decreased by 112 billion Won from 1,476.3 billion Won in 2011 to 1,364.4 billion Won in 2012, which was a reduction of the growth rate by 7.6%.

The proportion of the forestry GDP to the overall Korea GDP was no more than 0.1%. In contrast, GDPs of the “wood and wood products manufacturing sector”, the “pulp and paper manufacturing sector” and the “furniture and other products manufacturing sector” using wood as a raw material were 933 billion Won, 4,870 billion Won, and 4,402 billion Won, respectively, in 2012. The sum of domestic products from these three sectors accounted for 0.9% of the Korean overall GDP as 10,142 billion Won.



[Figure 6-4] National GDP, Agriculture, Forestry and Fishery GDP, and Forestry GDP

[Table 6-15] GDP and share of GDP by forestry-related sectors in 2012

Classification	GDP (Market Price)	Agriculture, Forestry & Fishery	Forestry	Wood & wood products	Pulp & paper	Furniture & other products
GDP (Billion Won)	1,104,215	27,687	1,364	933	4,807	4,402
Share(%)	100.00	2.51	0.12	0.08	0.44	0.40

※Note: Chained 2005 year prices

Korea's real GDP in 2012 showed a 2.0% growth on a year-on-year basis. However, agriculture, forestry and fisheries decreased by 0.9%, and forestry itself by 7.6%. Thus, it is apparent that domestic production from the primary industry of agriculture, forestry and fishery sectors does not meet a growth of the national economy.

Indicator 6-7 [MP 6.3.c] The mountain village experience programs: number of visitors and annual income

1) Definition and importance

This indicator provides information on the extent to which the mountain eco-villages as forest dependent communities have reacted to the changing socioeconomic conditions in terms of sustaining livelihood, income, improving quality of life, cultural identity and overall well-being. The Indicator for the number of visitors and resident income with the mountain village experience programs as core businesses of mountain eco-villages helps identify whether maintenance and development of mountain villages are able to be sustained. This indicator may also be used as a base to predict the current state and future prospects of each mountain eco-village.

2) Data status and trend

In Korea, social issues such as rural population decline and aging, weakness of production functions and degradation of living environment emerged along with the rapid urbanization in the 1970s. At present, many mountain villages face difficulties of maintaining their communities by their own capabilities.

The mountain villages development program began in 1995 to develop and promote mountain villages, and was renamed the mountain eco-village promotion project in 2007. Although not all the forest dependent communities were designated mountain eco-villages, the mountain villages already designated as mountain eco-villages come under forest dependent community category as they sustain their communities through forests. To be designated as a mountain eco-village, the candidate village must meet legal requirements as a mountain village, which are composed of the forest area ratio, population density and the ratio of arable land area, etc.

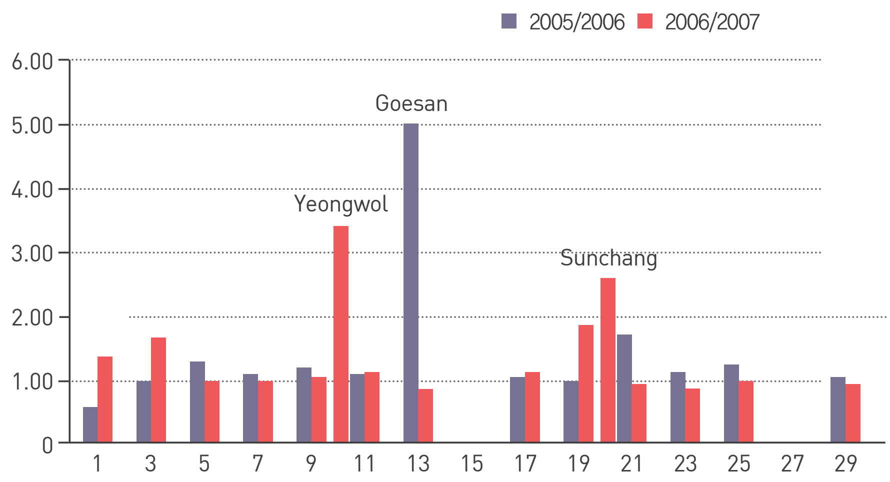
The mountain eco-village promotion project adopted “urban-rural exchange” as a key strategy to improve mountain villagers income and the living environment, which concentrates on experience tourism. It provides urban citizens with an opportunity for recreation using natural ecosystems and cultural assets of mountain villages, and through this process with the subsequent exchanges of human, material resources and information, economic returns and local vitalization are pursued. A total of 312 mountain eco-villages were designated as of 2013.

The number of visitors and the annual income were surveyed from 2005 to 2007 for 30 mountain eco-villages where experience tour programs were operated. The total number of visitors and the total annual income of all 30 villages increased by 8% and 19%, respectively, in 2007 compared to those of 2006, whereas the total number of visitors decreased by 13% and the total annual income increased by 23% in 2006 compared to those of 2005. As a result, it showed that mountain village experience programs had a positive impact on raising the income level of mountain eco-villages. In addition, as the annual income is increasing at a greater rate than the number of visitors, it is seen that the economic impact per visitor is getting bigger by activation of mountain eco-village experience programs. On the contrary, some of 30 mountain eco-villages showed decreasing trends both in the number of visitors and the annual income. Such villages had a common feature that the experience tour programs were monotonous and no differentiated from other villages programs.

[Table 6-16] No. of Visitors and Income of mountain eco-villages with experience tour programs (2005-2007)

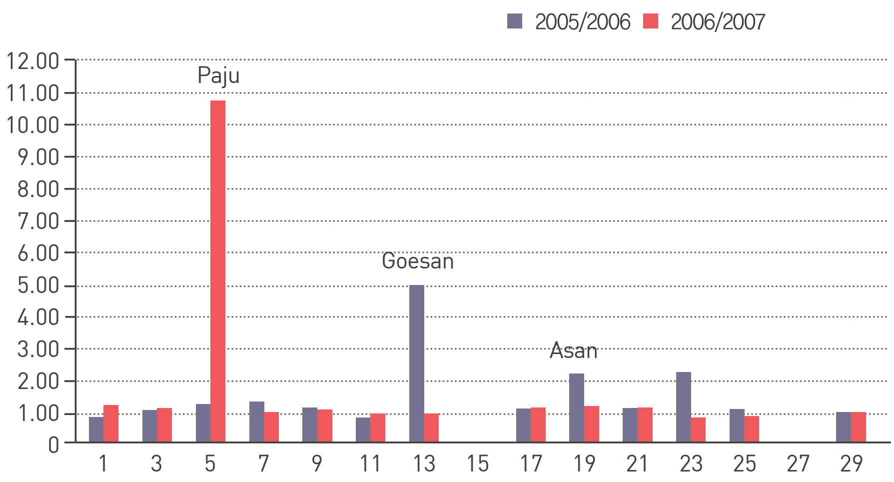
Mountain Village			Begun Year	# of Programs	2005		2006		2007	
					Total Income (1,000 Won)	Visitors	Total Income (1,000 Won)	Visitors	Total Income (1,000 Won)	Visitors
1	Gyeonggi	Yeoju Geumsa Jurok	2002	2	37,000	180	17,000	150	23,000	180
2	Gyeonggi	Yangpyeong Danwol Seoksan	1996	3	42,000	30,000	40,000	32,000	50,000	30,000
3	Gyeonggi	Yangpyung Cheongun Sinron	2000	4	5,000	4,300	5,000	4,500	8,000	5,000
4	Gyeonggi	Yangpyeong Seojong Myeongdal	2002	2	60,000	16,000	65,000	18,000	75,000	20,000
5	Gyeonggi	Paju Jeokseong Gaekhyeon	2001	3	30,000	3,000	38,000	3,700	40,000	40,000
6	Gangwon	Hwacheon Dongchon	2000	4	60,000	20,000	70,000	25,000	100,000	27,000
7	Gangwon	Inje Sangnam Misan	2001	3	40,000	15,000	45,000	20,000	45,000	20,000
8	Gangwon	Yangyang Hyeonbuk Eoseongjeon	1997	3	45,612	2,920	37,850	2,003	42,736	2,500
9	Gangwon	Gangneung Wangsan daegi	1999	3	30,000	2,800	40,000	3,123	45,000	3,500
10	Gangwon	Yeongwol Munsan	2004	5	-	-	6,000	300	20,000	400
11	Chungbuk	Danyang Gagok Eouigok	1998	4	240,586	33,908	254,557	27,879	279,047	27,228
12	Chungbuk	Jecheon Baekun Deokdong	2001	2	81,200	200,000	70,450	122,000	57,000	82,000
13	Chungbuk	Goesan Yeonpung Wonpung	1997	4	10,000	2,000	50,000	10,000	45,000	9,000

14	Chungbuk	Jecheon Bongyang Myeongam	2004	2	-	-	-	-	68,000	-
15	Chungbuk	Jecheon Songhak Omi	2004	3	-	-	-	-	21,000	-
16	Chungnam	Cheongyang Jangpyeong Dorim	2001	2	25,000	2,000	27,000	3,200	30,000	3,800
17	Chungnam	Hongseong Kwangcheon Damsan	2000	3	34,000	2,400	36,000	2,640	40,000	3,000
18	Chungnam	Nonsan Beolgok Manmok	2001	2	10,500	350	13,500	450	15,000	500
19	Chungnam	Asan Songak Geosan	2001	2	8,800	700	9,000	1,550	17,000	1,800
20	Jeonbuk	Sunchang Gurim Anjeong	1997	2	50,000	3,000	78,000	3,600	200,000	4,000
21	Jeonbuk	Jinan Baekun Sinam	2000	1	10,000	550	14,700	620	14,100	700
22	Jeonbuk	Namwon Jucheon Yonggung	1999	2	43,000	1,200	50,000	1,500	41,000	1,000
23	Jeonnam	Gurye Sandong Wian	1997	3	540,000	1,300	666,000	1,800	594,000	1,500
24	Jeonnam	Gwangyang jinsang bichon	2000	2	3,000	100	5,000	150	7,000	250
25	Gyeongbuk	Sangju Hwabuk ipseok	2002	1	36,000	2,400	38,000	2,600	34,000	2,200
26	Gyeongbuk	Yeongyang Subi sinwon	1997	1	60,000	400	80,000	600	80,000	600
27	Gyeongbuk	Yeongdeok Dalsan Okgye	2004	2	-	-	-	-	50,000	20,000
28	Gyeongnam	Geochang Buksang Wolseong	1995	4	-	-	95,626	12,000	159,552	16,000
29	Gyeongnam	Miryang Danjang Gucheon	2000	1	18,400	920	19,200	950	18,900	930
30	Gyeongnam	Namhae Samdong Bonghwa	2001	1	1,000	80	1,100	90	1,500	100



• Annual Income Ratio(2006/2005) : Increase – 26 villages, Decrease – 4 Villages
• Annual Income Ratio(2007/2006) : Increase – 23 villages, Decrease – 7 Villages

[Figure 6-5] Income changes in mountain eco-villages



• Annual Visitors Ratio(2006/2005) : Increase – 26 villages, Decrease – 4 Villages
• Annual Visitors Ratio(2007/2006) : Increase – 22 villages, Decrease – 8 Villages

[Figure 6-6] Changes in the number of visitors of mountain eco-villages

Indicator 6-8 [MP 6.4.a] Area and proportion of forests managed for public recreation and tourism

1) Definition and importance

This indicator provides information on the area and its proportion to the total land base designated and available for forest recreation and tourism activities. Such a proportion reflects to what extent a country recognizes the importance of forest recreation and tourism.

2) Data status and trend

In Korea, providing forest areas for recreation and relaxation is the most favored means of using forests and mountains[1]. It is also a common means to return the benefits of reforestation accomplished by the people's efforts back to the people. Thus, forest recreation has attracted much attention as one of the most important forest policies.

The area of forests for recreation and tourism is 665 thousand hectares, accounting for 6.64% of the total territory and 10.36% of the total forest area. In addition to the natural parks, the forest recreation infrastructures are continuing to expand in Korea, such as recreation forests, healing forests, forest bath areas, arboretums and forest museums.

[Figure 6-7] National parks in Korea (Source: http://english.knps.or.kr/)

Natural parks aim at protecting natural ecosystems and landscapes by promoting sustainable use, and contributing to people's health, leisure and emotion cultivation. There are 3 types of natural parks that are national park, provincial park and county

1) Survey of People's Awareness on Forests (KFS, 2010) indicated that 48.8% of respondents answered "providing forest areas for recreation and relaxation" was the most desirable way to utilize forests.

park. Since the responsible agency for the natural parks was transferred from the Ministry of Internal Affairs to the Ministry of Environment in 1998, natural park policies became more focused on environmental conservation. Since the establishment of the first national park, Mt. Jirisan National Park, in 1967, 21 parks have been designated as national parks. 16 of them are mountainous national parks and encompass 390,000 hectares of forested areas, accounting for 6.08% of the total forest area. Regarding the provincial park, since the first establishment of the Mt. Geumosan Provincial Park in 1970, 29 sites have been designated as provincial parks and occupy approximately 100,000 hectares, including marine areas. With regards to the county park, since the first establishment of the Mt. Gangcheonsan in 1981, 28 sites were designated as country parks in the areas of 23,000 hectares.

[Table 6-17] Forests designated for recreation and tourism

Classification		Area (ha)		Share (%) of the total national territory		Share (%) of the total forest area		Number of sites	
Year		2007	2014	2007	2014	2007	2014	2007	2014
Natural park	National park[2]	389,895	390,254	3.91	3.90	6.11	6.08	20	21
	Provincial park	78,382	100,500	0.79	1.00	1.23	1.57	23	29
	County park	44,148	23,974	0.44	0.24	0.69	0.37	33	28
	Sub-total	512,425	514,728	5.14	5.14	8.03	8.02	-	-
Forest recreation infrastructure	Recreation forest	135,481	129,556	1.36	1.29	2.12	2.02	126	152
	Healing forest	-	1,586	-	0.02	-	0.02	-	12
	Urban forest	-	2,557	-	0.03	-	0.04	-	2,280
	Forest bath area	7,261	9,651	0.07	0.10	0.11	0.15	122	173
	Arboretum & Forest museum	6,746	7,185	0.07	0.07	0.11	0.11	39	58
	Sub-total	149,488	150,535	1.50	1.50	2.34	2.34	-	-
Total		662,913	665,263	6.64	6.64	10.37	10.36	-	-

Along with the changes of socioeconomic conditions by the increased leisure time and

2) Areas excluding the marine areas

income, national demand for forest recreation and public health has largely increased. Forest recreation infrastructure such as recreation forest and healing forest has been consistently formed to meet the rising demands. It has been implemented as part of the "forest welfare" policies to promote public welfare, and its responsible agency is the KFS.

Recreation forests are "forests cultivated to promote emotional enrichment, healthy recreation and forest education for the people," and must have a minimum area of 20 hectares. A total of 152 recreation forests has been formed by 2013, amounting to a total area of 129,000 hectares. Healing forests are "forests providing healing services to boost the immune system and improve health through the environmental elements such as fragrance and scenery," and there are 12 sites with a total area of 1,586 hectares. Healing forests are expected to expand continuously as supportive scientific evidences and healing program development continue to grow, gaining more momentum. Urban forests are "forests formed and managed in urban areas for the purposes of public

[Figure 6-8] Various uses of mountainous recreation sites health, recreation, emotional fostering and experience activities of citizens." The urban forests can be easily accessed without cost, and contribute to environmental improvement in urban areas. A total of 2,280 urban forests has been created across 2,557 hectares. Their significance is expected to grow considering Korea's high degree of urbanization which is 91.1% in 2011 and becoming an aging society by 2026 which is projected to be more than 20% of the population aged over 65 years. A total of 173 forest bath areas across 9,651 hectares has been created in suburban forests, formed with trails, athletic facilities and natural education sites. As well, 58 arboretums and forest museums have been created across 7,185 hectares.

In conclusion, Korean forests designated for recreational purposes are divided into 2 types. One is the natural parks and the other the forest recreation infrastructures. Each type holds the areas of 515,000 hectares and 150,000 hectares, accounting for 8.02% and 2.34% of the total forest area, respectively, all together totalling 665,000 hectares that is 10.36% of the total forest area. It is characterized that natural parks occupy larger areas than those of forest recreation infrastructures, while the purpose and distribution of the forest recreation infrastructures are much more specified than those of natural parks.

Indicator 6-9 [MP 6.4.b] Number of visitors by type of forest recreation

1) Definition and importance

This indicator provides information on the types and levels of recreation and tourism activities in forests. The most acceptable forest benefits by the public is forest recreation, except for timber production. In this context, at the national level, the extent of participation in forest recreation reflects social use of forest resources and the significance of forests.

2) Data status and trend

The forest recreation population in Korea continues to grow, and reached an estimate of 406 million people as of 2013. The annual users of recreation forests exceeded 10 million. As the quantitative growth comes with the qualitative diversification at the same time, forest recreation activities has shifted from a vertical perspective such as mountain climbing, to a more horizontal perspective such as walking in forest trail. The annual users of forest trails, introduced in 2007, amounted to 400,000 people in 2012. In addition, the annual users of healing forests, forest education and forest kindergartens was 310,000, 500,000 youth and 430,000 children, respectively. These trends reveal that national demands for forest services have diversified in Korea.

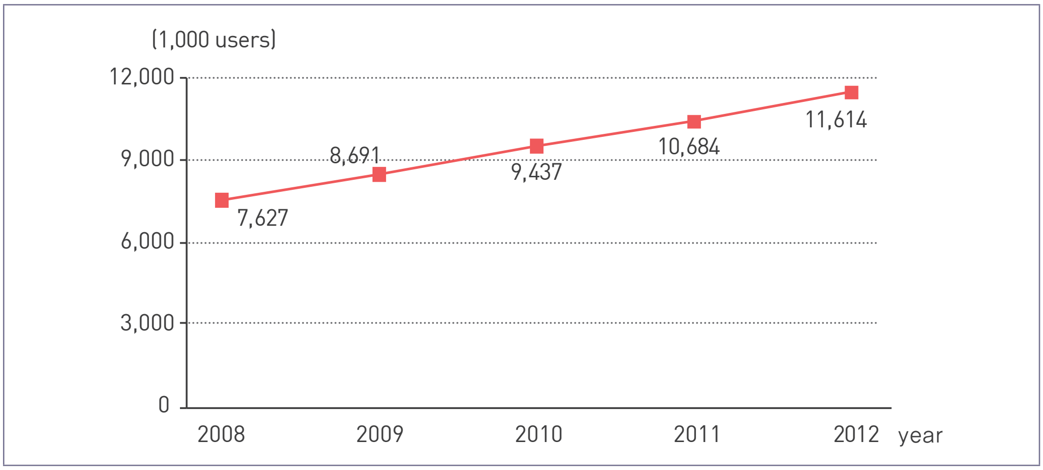
	Existing Recreation Activities		Diversified demands for forest welfare		
Content	Hiking, camping, forest bath, recreation forest		Forest trail/ trekking	Forest therapy	Forest education
Goal	Leisure, relaxation, hobby		Forest trail walks	Health improvement through forest activities	Nature experiences through forests
Effect	Emotional, psychological relaxation	⇨	Local culture/ history tour Health promotion	Prevent/heal ailments through strengthening immunity and de-stressing	Help understand forests Foster teamwork Overcome internet addiction Reduce school violence
Launching year	Natural recreation forests: 1988 Forest bathing: 1994		2007	2009	2012
Number of users	Hiking: 15 million Recreation forests: 12 million Bathing forests: 37 million Camping: 2.5 million (estimated)		Forest trails: 400,000 (estimated)	Healing Forests: 310,000 Forest healing programs: 30,000	Forest education programs: 940,000

[Figure 6-9] Diversification of demands for forest recreation

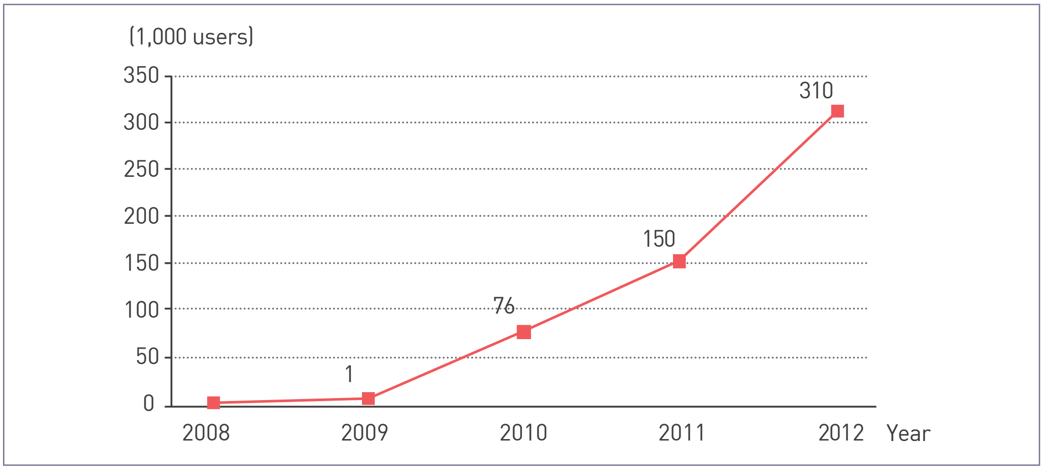
[Table 6-18] Number of forest users in 2010

(Unit: 1,000 persons)

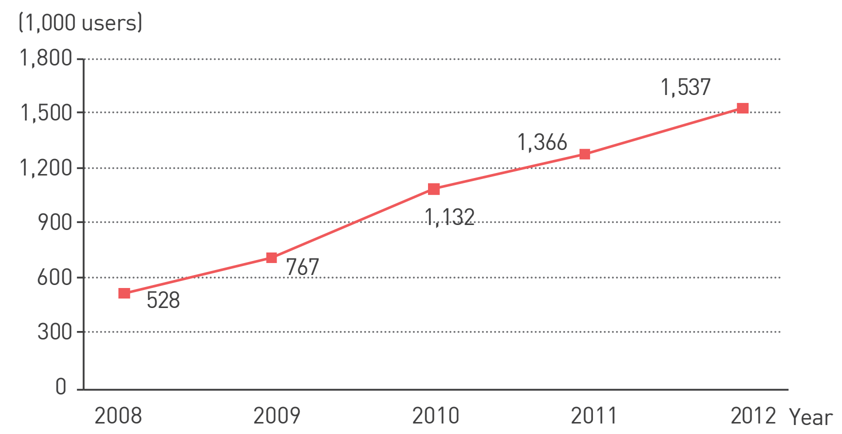
	%	Freq.	No. of people	Annual No. of people
Once a year	28.3	1	10,471	10,471
Once a quarter	12.4	4	4,588	18,352
Once a month	25.8	12	9,546	114,552
Once a week or more	14.8	48	5,476	262,848
Total	81.3	-	30,081	406,223



[Figure 6-10] Number of users in recreation forests



[Figure 6-11] Number of users in healing forests



[Figure 6-12] Number of users for forest explanation programs

In accordance with these trends, KFS announced the "Forest Welfare Comprehensive Plan" with a vision of "realizing an era of happiness through forest welfare" at the Forest Vision Proclamation Ceremony on July 24, 2013. KFS set the three key objectives in the plan which are to increase the per capita days available for forest welfare from 4 days to 8 days per year by 2017, to expand per capita area of urban forests from 7.95 m^2 to 8.6 m^2, and to train more personnel specializing in forest welfare from 4,545 to 15,000. These are to set the specific scale and extent of how forests can contribute to the people's happiness.

While the use of forests by the public had been irregular and oriented in forest recreation in the past, it has become more routine and diverse, closely related to the life cycle. As Korea enters an era of aging society and heavy urbanization at the level of more than 90%, it has become more difficult for ordinary people to get access to forests and ecosystems. Besides, the travel cost of visiting forests has become higher than the past. Under these circumstances, the significance of forest welfare will continue to grow for a happy and healthy life of the people at the national level.

Criterion 7 Legal, institutional, and economic frameworks for sustainable forest management

Indicator 7-1	Laws and policies supporting sustainable forest management
Indicator 7-2	Taxation and economic strategies that affect sustainable forest management
Indicator 7-3	Clarity and security of land and resource ownership and property rights
Indicator 7-4	Enforcement of forest-related laws
Indicator 7-5	Programs, services, and other resources to support sustainable forest management
Indicator 7-6	Development and application of research and technologies for sustainable forest management
Indicator 7-7	Public participation and dispute resolution in forest-related decision making

Legal, institutional, and economic frameworks for sustainable forest management

Criterion 7 includes qualitative indicators of legal, institutional and economic frameworks for sustainable forest management. Successful implementation of sustainable forest management requires establishment of associated legal and institutional systems, and economic instruments to ensure a certain level of financial profit. These legal, institutional and economic frameworks are crucial factors to create a basis for sustainable forest management. They guarantee to achieve a balance among the social, environmental and economic functions of forests by contributing to ensuring the sustainabilities of forest management activities.

Thus, it is important to meet the demands and needs of the people when forestry associated agencies within the central and local governments develop policies and perform related projects for sustainable forest management under the legal and institutional system. In addition, forestry related agencies are necessary to have capacities and means being able to implement forest policies and projects. In order to meet the diverse demands of people, public participation in the processes of policy decision making and project development should be assured, and the implementation of forest policies and projects kept transparent.

Indicator 7-1 [MP 7.1.a] Laws and policies supporting sustainable forest management

1) Definition and importance

Since forestry related laws and policies are established to reflect the social and environmental needs of the people, they may impose restrictions or regulations on certain management activities of forest owners, resulting in some negative impacts on economic revenues of forest owners generated from forest management. However, these forest-related laws and policies create a framework being able to implement SFM and guarantee a balanced approach for social, environmental, and economic functions of forests by ensuring the continuities of forest management activities.

2) Data status and trend

The Korean government has set up the legal framework and developed policies in order to ensure the sustainabilities of the social, environmental and economic functions of forests.

The Forest Law revised in 1994 introduced the concept of SFM to be reflected in the National Forest Plan, and was enforced to assess its implementation through 6 criteria of the Montreal Process such as conservation of biological diversity and maintenance of productive capacity of forests *etc.*

In 2001 the Framework Act on Forest was enacted replacing the existing Forest Law. The Article 2 of this Act declared that as forests, as a foundation for the conservation of land and production of forest products, are crucial assets which are indispensible for the national development and survival of all living organisms, SFM should be achieved by harmonizing the conservation and use of forests, the Article 3 defined the SFM and the Article 13 stipulated the criteria and indicators for SFM. In 2006 the Act on Promotion and Management of Forest Resources was enforced to consider criteria and indicators for SFM in forest management, and to develop the forest sustainability index in order to assess the extent of forest sustainability at the national and sub-national levels. Thus, a legal framework was reinforced to implement SFM at all levels of forest policies.

The Framework Act on Forest stipulates to renew the National Forest Plan every 10 years. A foundation for SFM was established through the 4th National Forest Plan from 1998 to 2007 by developing the national criteria and indicators for SFM and reinforcing the related raws and regulations. The fifth national forest plan, which is now going on from 2008 until 2017, set a vision of sustainable green welfare nation by spreading the implementation of SFM.

[Table 7-1] **Forest-related legislations in Korea**

Name	Date of Enactment	Key points
Act on Erosion Control	1962. 1.15	National erosion control measures against forest devastation
Act on Forest Protection Guards	1963. 2. 9	Arrangement of forest guards to protect the forests and prevent potential forest damages
Act on Forestry Cooperatives	1980. 1. 4	Formation and management of forestry cooperatives
Act on Promotion of Forestry and Mountain Villages	1997. 4.10	Promotion of forestry and mountain villages and rights of forest owners
Arboretum Establishment and Promotion Act	2001. 3.28	Establishment of Arboretums, and management and conservation of forest genetic resources
Framework Act on Forest	2001. 5.24	Dictating the fundamental principles of forests and forestry
Act on Forest Land Management	2002.12.30	Rational conservation and utilization of forest lands
Baekdudaegan Mountains Protection Act	2003.12.31	Systematic protection and management of Baekdudaegan Mountains
Special Act on Pine wilt Disease Control	2005. 5.31	Damage prevention and control against *Bursaphelenchus xylophilus* disease
Act on Promotion and Management of Forest Resources	2005. 8. 4	Promotion, management and protection of forest resources
National Forests Management Act	2005. 8. 4	Efficient management and maintenance of national forests
Forest Culture and Recreation Act	2005. 8. 4	Promotion of forest culture and recreation
Act on Restructuring Forestry Cooperatives	2007. 8. 3	Restructuring poor forestry cooperatives
Forest Protection Act	2009. 6. 9	Management of forest reserves, and protection of forests from fires, landslides and pests and diseases
Act on Forest Land Management of the North Region above the Civilian Control Line	2011. 4. 4	Restricted activities and supporting the local residents in the above the CCL
Act on Vitalization of Forest Education	2011. 7.25	Empowering forest education programs to promote community development and improve quality of life
Act on the Management and Improvement of Carbon Sink	2012. 2.22	Sustaining and improving the carbon absorbing function of forests to take measures against the climate change
Act on Sustainable Use of Timber	2012. 5.23	Promoting timber use, timber culture and timber industry

Indicator 7-2 [MP 7.2.a] Taxation and economic strategies that affect sustainable forest management

1) Definition and importance

Forest management involves a higher risk of investment because it has a long payback period and is always exposed to potential damages from natural disasters. However, in consideration of the public benefits such as supply of clean water and fresh air as well as the economic benefits generated from forests, it is necessary to provide forest owners with direct support through loans or capital investments and as well indirect support through tax incentives in order to encourage forest investments. To ensure the implementation of sustainable forest management, tax incentives by exemption or reduction of taxes related to forestry such as income tax, corporate tax, inheritance tax, gift tax, value added tax, property acquisition tax, property tax and integrated real estate tax and low interest rates of loans have been offered by the government.

2) Data status and trend

To compensate a long-term period of return and low profitability of forestry and alleviate financial burdens of small scale forest holders, the government has provided low interest rate loans of 1.5–4.0%, which were lowered from 3-5%, for 17 forest items related to wood and non-wood forest products production since 2006. The rates are 1.5% for long-term projects, 3% for forest owners and 4% for non-forest owners.

Meanwhile, in order to expand forest management infrastructures by accelerating forest mechanization, tax relief measures have been implemented with introduction of tax exemption on petroleum used for forestry from 2002, extended until the end of 2015. In addition, to give less burdens of purchasing forestry equipments, the deadline to apply for a zero VAT for them was extended to the end of 2014, and an exemption measure was also taken with the local property acquisition tax when the forest owners dedicated to forestry businesses purchase forest lands. The tax incentives for forestry was further expanded since 2008 by separating property tax scheme on forest properties under a semi-conservation forest land with a approved forest management plan, excluding urban areas, from the general comprehensive accumulative taxation scheme.

[Table 7-2] Loan scale and conditions for the Comprehensive Forestry Project Fund (2014)

Forest business projects	Funding (million Won)	Interest rate (%)	Loan Period	
			Deferral (year)	Redemption (Year)
1. Forest tending	428	1.5	10~20	5~15
2. Forest road building	274	1.5	20	15
3. Supporting fund for forest owners	14,398	1.5~3.0	10~20	10~15
4. Establishment of private arboretums	500	3.0	10	10
5. Establishment of private recreation forests	800	3.0	10	10
6. Fund for forest-cultivated ginseng	1,000	3.0	10	5
7. Overseas forest investment fund	6,000	1.5	7~25	3
8. Short-term non-wood product support fund	44,816	3.0	3~5	2~7
9. Seedling production for reforestation	1,600	3.0	3	2
10. Forestry mechanization	500	3.0~4.0	3	7

[Table 7-3] Tax relief schemes for forestry sector

Type	Tax relief summary
Income Tax	• Tax exemption for the annual income of less than 6 million Won generated from logging or transferring ownership of a forest property with an reforestation period of 5 years or more • 50% tax reduction (income tax or corporate tax) for the income generated from logging or transferring ownership of forests reforested for over 10 years by Dec 31, 2015: forests managed in line with a forest management plan or special forestry regional project, the seed producing forests, and forest protection areas designated by the article 7 of the Forestry Protection Act
Corporate Tax	• Special tax relief for local forestry cooperatives (excluding a national entity) and joint co-op corporate entities
Inheritance Tax	• Tax deduction up to a maximum amount of 500 million Won from applicable tax base when transferring ownership of the following forests to agricultural inheritors or forest successors: as a conservation forest, reforested for longer than 5 years in line with a forest management plan or special forestry regional project
Gift Tax	• Tax reduction or exemption in case of gifting the following forests to the descendants of an agricultural family: as a conservation forest, forests, including forest conservation reserves, seed producing forests, protected areas under the article 7 of the Forest Protection Act, reforested for more than 5 years in line with a forest management plan or the special forestry regional project, up to a maximum area of 297,000 m^2, or 990,000 m^2 if the forest has been reforested for over 20 years
Value Added Tax	• Total tax exemption for the forestry equipments provided (or sold) to forest owners • VAT exemption for petroleum used for 10 categories of forestry machineries
Acquisition Tax	• Tax exemption for primary foresters or forest successors in case of forests acquired, exchanged, divided or amalgamated for the purposes of direct participation in forestry works

※Source : Homepage of the National Forestry Cooperative Federation

Indicator 7-3 [MP 7.3.a] Clarity and security of land and resource ownership and property rights

1) Definition and importance

In Korea, the Article 4 of the Act on Promotion and Management of Forest Resources stipulates the classification of forests according to their ownerships as National forests owned by the state, Public forests owned by local governments and other public entities and Private forests owned by individuals. Property protection, exercise of rights and dispute resolution for forests are important for SFM because the forest dependent residents can continue to make efforts for SFM only when their forest ownership and ute of forest resources are guaranteed.

2) Data status and trend

All property and ownership rights of all land in Korea are clearly defined and ensured in the Constitution, with legal measures in an individual law to resolve disputes. When a transfer of ownership occurs following acquisition and status change of real estate, it must be registered in compliance with the "Civil Law and Real Estate Registration Act" in order to exercise property rights. The following Table shows the status of forest areas by ownership category registered in compliance with the associated law.

[Table 7-4] Status of forest area by ownership (2012)

Classification	Land area	Forest area								
		Total	National ownership			Public ownership			Private ownership
			Subtotal	KFS	Others	Subtotal	Province	County	
Area (1,000 ha)	10,003	6,368	1,543	1,410	133	487	154	333	4,338
Territorial proportion (%)	-	63.7	15.4	14.1	1.3	4.9	1.5	3.4	43.4
Total forest proportion (%)	-	-	24.2	22.1	2.1	7.7	2.4	5.3	68.1

Indicator 7-4
[MP 7.3.b]

Enforcement of forest-related laws

1) Definition and importance

Laws and regulations to implement the conservation and management of sustainable forests are being enforced through guidance, supervision, and monitoring measures by collaborative administration forces of the forestry-related authorities of both the central and local governments.

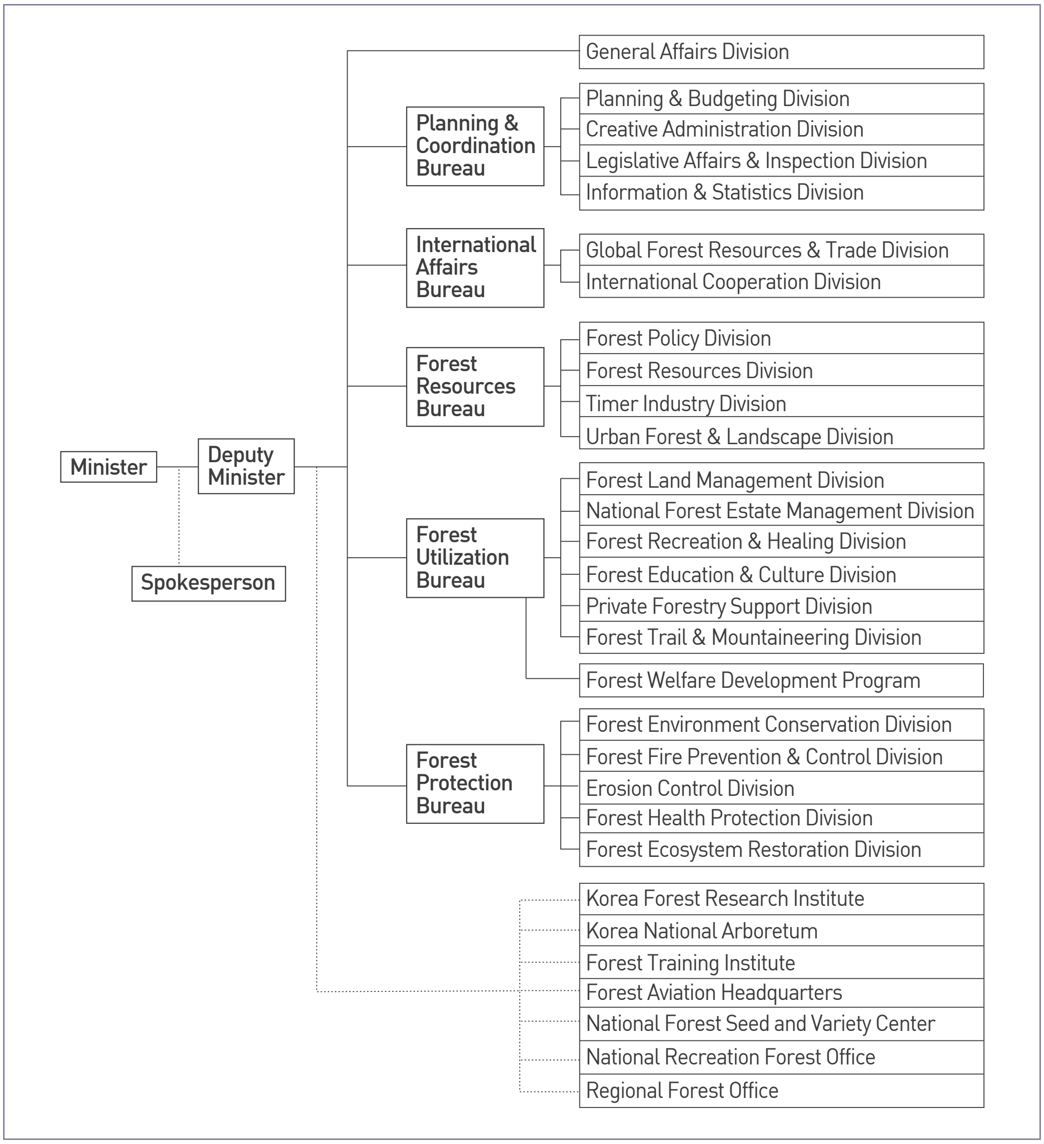
2) Data status and trend

KFS under the central government develops policies to execute laws and regulations, whereas forestry-associated authorities under the local governments mobilize administrative forces to enforce guidance and supervising measures to implement SFM at the local level.

In case that SFM is not implemented properly, head of the local government may recommend or instruct forest owners to correct. In addition, manuals introducing forest policies and their contents and procedures are distributed and guided by forest extension personnels. Policing power is given to some of forestry officials of the central or local government in order to monitor and crack down on illegal logging, deforestation and forest fires.

[Table 7-5] Number of forest-related officers in central and local governments (2013)

<table>
<tr><th># of forest officers</th><th colspan="11">Central government</th><th>Local government</th></tr>
<tr><th rowspan="2">Grand Total</th><th rowspan="2">Total</th><th colspan="3">KFS</th><th colspan="7">Sub-organizations under KFS</th><th rowspan="2">Province, City, County</th></tr>
<tr><th>Sub total</th><th>HQ</th><th>Regional Office</th><th>Sub total</th><th>KFRI</th><th>KNA</th><th>Forest Training Institute</th><th>Forest Aviation HQ</th><th>KSVC</th><th>Office of National Recreation Forests</th></tr>
<tr><td>6,455</td><td>1,584</td><td>979</td><td>265</td><td>714</td><td>605</td><td>239</td><td>59</td><td>34</td><td>153</td><td>33</td><td>87</td><td>4,871</td></tr>
</table>



[Figure 7-1] Organizational chart of the Korea Forest Service

Indicator 7-5
[MP 7.4.a]

Programs, services, and other resources to support sustainable forest management

1) Definition and importance

Expertise and technical training needs to implement SFM. This indicator provides information on the capacity of government or forest organizations to deliver programs and services necessary for field operations by forest officers in implementing SFM.

2) Data status and trend

The official data employed briefly describe the operation support system and various training programs by KFS, the Forest Training Institute, and the National Forestry Cooperative Federation.

KFS has been operating 15 types of forestry information systems such as GIS system, mobile field operation system, forest projects management system and video conference system with annual training programs to support those who are responsible for managing the national and private forests. The Forest Training Institute annually runs 89 forestry training courses for the field practitioners of the national, public and private forests, forest owners and general public. The National Forestry Cooperative Federation has run professional training institutes such as the Forestry Technology Training Institute and the Forestry Machinery Training Institute to cultivate professional forestry engineers and experts.

[Table 7-6] Status of programs by the Forest Training Institute of KFS

Training Category	Number of courses	Key points
Basic training	2	Train new officials and transferring field practitioners
Professional training	58	Train field practitioners in common capacity building for general duties and duty-specific professional capacity development
Online training	15	Duty-specific professional capacity building through online courses
Public training	12	Experience-centered forest management training for the general public
Foreigners training	2	Train various visiting forestry officials from foreign countries
Total	89	

Indicator 7-6 [MP 7.4.b] Development and application of research and technologies for sustainable forest management

1) Definition and importance

Korea has adopted SFM as the basic principle of forest management since the early 1990s, and it is stipulated in the Framework Act on Forest. This indicator shows the status of researches and developments for SFM.

2) Data status and trend

KFRI's SFM related studies and other studies undertaken in association with the Jeju Experimental Forest will be briefly illustrated to describe this indicator.

During 2001 to 2004, KFRI conducted a study, 'Monitoring methods to develop and measure local indicators for SFM,' in the Woonduryung area of Gangwon-do. Through this study, seven criteria and 47 indicators for SFM at the local level were adopted. And the Jeju Experimental Forest of the Warm-Temperate and Subtropical Forest Research Institute was chosen to conduct field experiments and monitor indicators for SFM.

The Jeju Experimental Forest developed the forest management plan (2006–2015) for SFM in 2005 and obtained international FSC forest certification in 2006, the first of its kind in Korea. The plan has been implemented under the project objectives and specific working guidelines as required by international standards. Moreover, management performance has been evaluated through the "Monitoring study on the indicators for SFM (2006–2015) of the Jeju Experimental Forest" since 2006, and the procedures and guidelines for improvement are in development to be reflected in the renewed forest management plan.

Indicator 7-7 [MP 7.5.b]

Public participation and dispute resolution in forest-related decision making

1) Definition and importance

It is important to make legal and institutional mechanisms to ensure the participation of the stakeholders or general public in the forest policy making processes. Since the participation of the public in decision making processes of forest policies helps understand forest policies and management activities, it can draw a wide range of support and cooperation from the people on the implementation of SFM.

2) Data status and trend

These are the typical cases of ensuring participation of stakeholders in forest policy processes in Korea:

- Submit annual reports on forests and forestry trends and policies to the parliament by the Framework Act on Forest, with which guarantees the citizens's right to know about what is going on forests and forestry.
- Listen to the local opinions and reflect them onto project planning such as the forestry promotion plan or the comprehensive mountain village development plan. Especially, public hearing or consultations with the locals are mandatory regarding designation of forest protection reserves or landslide-susceptible areas, and should it conflict with the locals' property rights, a channel of appeal is also available for conflict resolution by the Act on Promotion of Forestry and Mountain Village and the Forest Protection Act, *etc*.
- Seek the local opinions in the process that the Regional Office of the KFS and the National Forest Station invite local residents into the national forest management advisory committees or local councils as a means to promote understanding and participate in the decision making processes of developing the national forest projects and the comprehensive national forest plans by the National Forests Management Act.
- For evaluation and review of forest policies, the Forest Policy Evaluation Committee is comprised of 10 to 30 members with a expert knowledge and experience on forest

policy evaluation or forest administration, appointed by the Minister of KFS. The committee mainly evaluates and reviews the main KFS policies, fiscal businesses, research and development projects, IT projects and administrative achievements in order to get feedbacks for the future policy implementation by the Operation Regulation of the Forest Policy Evaluation Committee.

Conclusions

The National Report on Sustainable Forest Management in Korea 2009 collected and analyzed data based on the 7 criteria and 28 indicators chosen by the Korea Forest Service in 2005. This 2014 national report analyzed of the significance and data trends based on 36 indicators out of the 54 indicators from the Montreal Process. The remaining 19 indicators among the Montreal Process indicators were insufficient to apply in terms of data availability. There is a need to be included in the future national reports through research and development on measuring and monitoring methods for the 19 indicators not available in this national report.

The criterion 1 of the conservation of biological diversity was assessed by 8 indicators including forest area by ecosystem type. Forest areas have shown a steady decrease due to the conversion of forests to industrial sites, road construction and housing development. Even though the conversion area was at 10,188 hectares in annual average during 2009 to 2013, but it is getting better by declining to 7,432 hectares in 2013. Per ha average growing stock has sharply increased from 23.09 m^3 in 1981 to 125.62 m^3 in 2010, and age-class I, II, III declined significantly whereas age-class IV, V, VI increased largely. Shrinkage of coniferous forests becomes problematic because, comparing to 1990, coniferous forests decrease by 498,000 hectares, whereas broadleaf and mixed forests increase by 330,000 hectares and 55,000 hectares, respectively. Compared to 1995, national forests increased by 151,000 hectares (11%) whereas public and private forests decreased by 5% and 1%, respectively. Protected forests have largely increased through expansion of Baekdudaegan Reserves and Forest genetic resource reserves. It complies to recommendation of the Convention on Biological Diversity to designate 17% of the global territory as protected areas. Species at risk of extinction in total increased from 221 species in 2005 to 246 species in 2012, however, to improve the circumstances, Korea Forest Service has designated and managed the Specially Protected Species within forests by the Forest Protection Act since 2012.

The criterion 2 of the productive capacity of forests was assessed by 4 indicators including annual timber harvest over annual net volume growth. Forest area available for timber production is regarded working forest area of 4.86 million hectares, however it is necessary to redefine the timber production forests. The annual average growth volume in the working forest area was 26.517 million m^3 for the last 15 years, and the annual volume cut merely 3.5 million m^3 so that it appeared to produce timber only at the level of 14% compared to the annual growth.

The criterion 3 of the forest ecosystem health and vitality was assessed by 2 indicators, biotic and abiotic causes, affecting forests. Recently pine wilt disease and oaks wilt disease are expanding. Forest fires in 2012 significantly declined as it was only 46% and 6% of the annual average incidence and damage area, respectively, over the past decade from 2003 to 2012, during which 387 fires occurred damaging 734 hectares in an annual average. The main causes of fires come from neglectful mistakes of people by accidental burning. Landslides area in 2012 was reduced at the level of 88% of the annual average of 558 hectares over the past 10 years.

The criterion 4 of the conservation and maintenance of soil and water resources was assessed by 4 indicators including area designated for soil and water protection. Watershed conservation forests and water protection zones to protect upstream water maintain about 270,000 hectares and 120,000 hectares, respectively. Hillside erosion control method is being practiced in an annual average of 86 hectares, and preventive erosion control projects since its introduction in 1996 continuously increased and performed 48 hectares in 2012. In the past fifteen years from 1996 to 2010, broadleaf forests dropped from pH 5.39 to pH 5.16, and conifer forests from pH 4.92 to pH 4.75, indicating the worsening soil acidification in forests.

The criterion 5 of the forest contribution to the global carbon cycle was assessed by 2 indicators including total carbon stock in forest biomass. Total forest product carbon pools and fluxes and avoided fossil fuel carbon emissions by using forest biomass for energy, required from the Montreal Process indicators, remain to be solved afterwards. As of 2010 the total carbon stock in the forest biomass of Korea amasses up to 429,289 thousand tC, which is a 3-fold increase, and the net annual CO_2 removals of forests is 59.7 million tCO_2, which is 17 times increment from 1990.

The criterion 6 of the maintenance and enhancement of socio-economic benefits of forests was assessed by 9 indicators such as values, quantities and consumption of wood and non-wood products. Fiberboard, particleboard, pulp and paper productions have increased while plywood production are decreasing every year. Value of non-wood forest products was 388.1 billion Won, which was 91.6% of total value of wood and non-wood products and continuously increasing. Even though wood consumption increased from 21,746 thousand m^3 in 1990 to 27,970 thousand m^3 in 2000, per capita wood consumption did not show a big difference when it was 0.51 m^3 in 1990 and 0.55 m^3 in 2012. Employment of forest workers has not been stable since the average annual days of employment were 179 days for the national forest workers and 129 days for the private forest workers. Forest sector GDP in 2012 was merely 1.3644 trillion Won, contributing only 0.1% of total GDP of 1,104 trillion Won. However, GDP from the "wood and wood products manufacturing sector", the "pulp and paper manufacturing sector" and the "furniture and other product manufacturing sector" accounted for 0.9% of the overall GDP of Korea, with a total of 10.142 trillion Won in 2012. The area of forests for recreation and tourism is 665,000 hectares accounting for 6.64% of the total territory and 10.36% of the total forest area. Paradigm change in forest recreation from 'peak-conquering' to 'horizontal leisure' led to wider forms of participation with 400,000 people on forest trails, 310,000 people using healing forests, 500,000 people benefitting from forest education and 430,000 children enjoying forest-for-kids programs.

The criterion 7 of the legal, institutional, and economic frameworks for sustainable forest management was assessed by 7 qualitative indicators. policy and institutional foundations for the implementation of SFM were accomplished through enacting the Framework Act on Forest and the Forest Resources Formation and Management Act and incorporating them into the national forest plan.

In Korea, forest productivity has improved in good condition and biodiversity has grown as well through increment of forest growing stock and expansion of forest protection areas. But, forest conversion, unbalanced age-class, needs of demarcation of timber production forest, prevention of forest pests and diseases, forest soil acidification and unstable employment of forest workers, *etc*. are problems to overcome in the future.

The criteria and indicators for SFM serve as a vehicle to assess the trends of forests objectively at the national level and to provide policy-makers with information on progress toward SFM to make the best decision in return. In this regards, we need to develop a system to collect serial data related to each indicator systematically and to assess and report the status of forestry properly at the national level.

References

(1) Korea Forest Research Insitute. 2009. National Report on Sustainable Forest Management in Korea 2009. KFRI Research Report 09-13 (in Korean). 141p.

(2) Korea Forest Research Insitute. 2013. The genetic structure of the primary stand in Mt. Sobaeksan and its genetic conservation.

(3) Korea Forest Research Insitute. 2014. What shall we do about Abies koreana of Mt. Hallasan?

(4) Korea Forest Service. 1998. A Guide to the Rare and Near-Extinction Plants of Korea

(5) Korea Forest Service. 2008. the 5th National Forest Plan. pp. 192.

(6) Korea Forest Service. 2009. National Report on Sustainable Forest Management in Korea 2009. 151p.

(7) Korea Forest Service. 2010. Biodiversity and Forest. pp. 127.

(8) Korea Forest Service. Statistical yearbook of Forestry. Yearly published.

(9) Korea National Arboretum. 2008. Rare Plants Catalogue of Korea

(10) Korea National Arboretum. 2014. Korea Standard Plants Inventory (http://www.nature.go.kr/)

(11) Lee, Changbok. 1987. Distribution and protective measures for the rare plants of Korea. Journal of Nature Conservation 59: 15-21.

(12) Ministry of Environment (MoE). 2014. http://www.cbd-chm.go.kr

(13) Park, Mangyu. 1975. A survey of extinct, near-extinct, and rare plants in Korea. Journal of Nature Conservation 9(Special): 3- 24.

(14) The Montreal Process. 2009. Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests. the Fourth Edition. 48p.

Appendix Montreal Process Criteria and Indicators

Criterion	Indicator
1. Conservation of biological diversity	1.1. Ecosystem diversity a. Area and percent of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure b. Area and percent of forest in protected areas by forest ecosystem type, and by age class or successional stage c. Fragmentation of forests 1.2. Species diversity a. Number of native forest associated species b. Number and status of native forest associated species at risk, as determined by legislation or scientific assessment c. Status of on site and off site efforts focused on conservation of species 1.3. Genetic diversity a. Number and geographic distribution of forest associated species at risk of losing genetic variation and locally adapted genotypes b. Population levels of selected representative forest associated species to describe genetic diversity c. Status of on site and off site efforts focused on conservation of genetic diversity
2. Maintenance of productive capacity of forest ecosystems	a. Area and percent of forest land and net area of forest land available for wood production b. Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production c. Area, percent, and growing stock of plantations of native and exotic species d. Annual harvest of wood products by volume and as a percentage of net growth or sustained yield e. Annual harvest of non-wood forest products
3. Maintenance of forest ecosystem health and vitality	a. Area and percent of forest affected by biotic processes and agents(e.g. disease, insects, invasive species) beyond reference conditions b. Area and percent of forest affected by abiotic agents (e.g. fire, storm, land clearance) beyond reference conditions

Criterion	Indicator
4. Conservation and maintenance of soil and water resources	4.1. Protective function a. Area and percent of forest whose designation or land management focus is the protection of soil or water resources 4.2. Soil a. Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources b. Area and percent of forest land with significant soil degradation 4.3. Water a. Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources b. Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical or biological properties from reference conditions
5 .Maintenance of forest contribution to global carbon cycles	a. Total forest ecosystem carbon pools and fluxes b. Total forest product carbon pools and fluxes c. Avoided fossil fuel carbon emissions by using forest biomass for energy
6. Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies	6.1. Production and consumption a. Value and volume of wood and wood products production, including primary and secondary processing b. Value of non-wood forest products produced or collected c. Revenue from forest based environmental services d. Total and per capita consumption of wood and wood products in round wood equivalents e. Total and per capita consumption of non-wood forest products f. Value and volume in round wood equivalents of exports and imports of wood products g. Value of exports and imports of non-wood forest products h. Exports as a share of wood and wood products production and imports as a share of wood and wood products consumption i. Recovery or recycling of forest products as a percent of total forest products consumption 6.2. Investment in the forest sector a. Value of capital investment and annual expenditure in forest management, wood and non-wood forest product industries, forest-based environmental services, recreation and tourism b. Annual investment and expenditure in forest-related research, extension and development, and education

Criterion	Indicator
6. Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies	6.3. Employment and community needs a. Employment in the forest sector b. Average wage rates, annual average income and annual injury rates in major forest employment categories c. Resilience of forest-dependent communities d. Area and percent of forests used for subsistence purposes e. Distribution of revenues derived from forest management 6.4. Recreation and tourism a. Area and percent of forests available and/or managed for public recreation and tourism b. Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available 6.5. Cultural, social and spiritual needs and values a. Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and values b. The importance of forests to people
7. Legal, institutional and economic frameworks for forest conservation and sustainable management	7.1.a Legislation and policies supporting the sustainable management of forests 7.1.b Cross sectoral policy and programme coordination 7.2.a Taxation and other economic strategies that affect the sustainable management of forests 7.3.a Clarity and security of land and resource tenure and property rights 7.3.b Enforcement of laws related to forests 7.4.a Programmes, services and other resources supporting the sustainable management of forests 7.4.b Development and application of research and technologies for the sustainable management of forests 7.5.a Partnerships to support the sustainable management of forests 7.5.b Public participation and conflict resolution in forest-related decision making 7.5.c Monitoring, assessment and reporting on progress towards sustainable management of forests

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A team of experts from the KFRI and the Korea National Arboretum (KNA) was also formed to prepare the national report. Korea as a member of Montreal Process chose 36 indicators, in terms of data availability, out of the 54 indicators of the 7 criteria of the Montreal Process in order to analyze the data trends of each indicator.

This national report was prepared and co-authored by specialized experts for each criterion and indicators as follows:

- Biological diversity: Jung Hwa CHUN, Seung Hwan OH, Kyung-nak HONG
- Productive capacity of forests: Se kyung CHONG, Hyun-kyu WON

- Forest Health and vitality: Chang-woo LEE
- Soil and water conservation: Hyung-tae CHOI
- Forest contribution to global carbon cycle: Young-hwan KIM
- Socioeconomic benefits of forests: Chul Sang KIM, Seong-youn LEE, Tongil KIM
- Legal, institutional and economic framework: Kyung Seok PARK, Hyun-kyu WON

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Finally, I wish to congratulate publishing this report successfully.

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