State of Japan's Forests and Forest Management

— 3rd Country Report of Japan to the Montreal Process —

July, 2019

Forestry Agency, Japan

This report was prepared by the Forestry Agency, Japan to provide information on the state of its forests and forest management in accordance with the Criteria and Indicators of the Montreal Process.

FOREWORD

The Montréal Process is one of the initiatives to promote the development and application of criteria and indicators for sustainable forest management. Twelve major temperate and boreal forest countries, including Japan, have participated in the Montréal Process, and the forest area of these countries is equivalent to 50 % of the world.

Efforts to promote sustainable forest management have been made in various forms since the agreement at the Earth Summit in 1992. As a recent movement, 17 Sustainable Development Goals (SDGs), which are an urgent call for action by the international community by 2030, was adopted at the United Nations Summit in 2015. Forests play important role in achieving SDG15 “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”, and contribute to 14 goals such as water, energy, climate change, consumption and production, etc.

Also, Paris Agreement, adopted at COP 21, encouraged that all countries to take action to strengthen the role of forest as carbon sinks and reservoirs, and also encouraged implementation and support of REDD +.

Meanwhile, as forest resources mainly in artificial forests have become enriched in Japan, the population declines and the aging progresses, and this trend is particularly intensifying in the mountain area that supports the production activities of forestry. For this reason, in addition to promoting the growth industrialization of forestry, stakeholders decided to work together on the initiative to construct a new system for appropriate forest management, and in 2018, new forest management Law "was enacted, and the introduction of a new tax system was also decided to secure the necessary financial resources for this.

Based on such internal and external circumstances, the Third Country Report was compiled adding new data, keeping the consistency with the trends of each indicator concerning Japan's forests since the Second Country Report in 2009. It is my hope that this report will widely acquaint the world with the state of forests and forest management of Japan and contribute to further promotion of sustainable forest management.

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July 2019

ACKNOWLEDGEMENTS

This report is a result of the efforts of many people and organizations, whose contributions are briefly described and acknowledged, as follows:

Senior Policy Analyst for International Affairs and members of the International Forestry Cooperation Office took the lead in a series of works, under the management by the Director for International Forestry Cooperation including collection, processing and illustration of the data and information, drafting of the report and consultations, coordination with relevant organizations, editing of the report.

Members of the relevant divisions of the Forestry Agency, Japan provided useful recommendations and advices, as well as necessary data and information, to make this report precisely.

Dr Satoru MIURA, Director, Center for Forest Restoration and Radioecology, Forestry and Forest Products Research Institute and Dr Hideki SAITO, Team Leader of wide area monitoring, Department of Forest Management, Forestry and Forest Products Research Institute and many other researchers provided data and information and useful advices.

All these contributions are deeply appreciated.

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－Overview of Japan’s Forests, Forestry and Wood Industry－

Features of forest

Japan has a narrow land area stretching over 3,000km from north to south, where boreal, cool temperate, warm temperate and sub-tropical forests are distributed along these climatic zones. These forests are affected by the human intervention and natural conditions such as distinct monsoons in summer and winter, as well as intricate geographical and geological features.

Figure i: Vegetation map

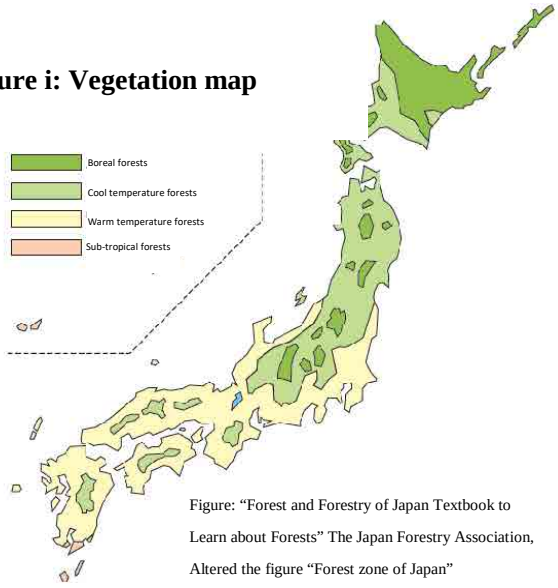


Figure: “Forest and Forestry of Japan Textbook to Learn about Forests” The Japan Forestry Association, Altered the figure “Forest zone of Japan”

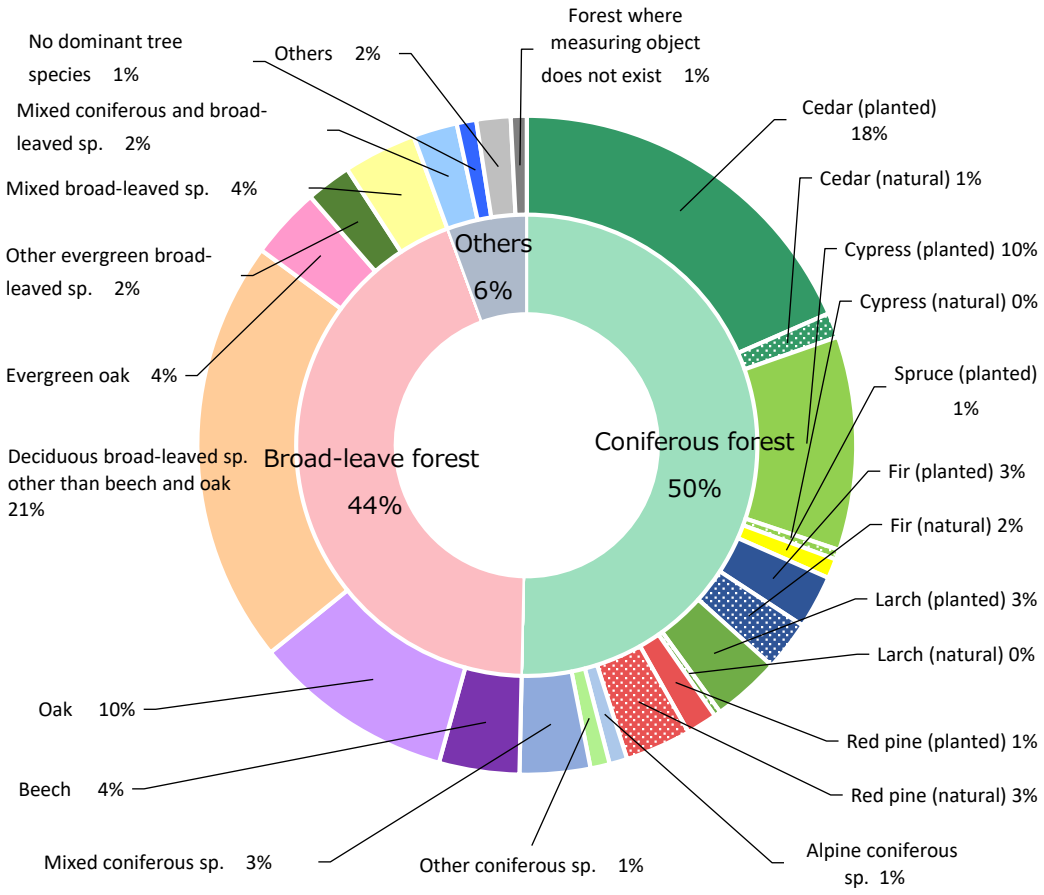
The total area of Japan’s forests is approximately 25 million ha, which corresponds to about two-thirds of the total land area. The coverage of forests has been maintained for more than a half century. While there are long history protecting forests by establishing systems such as harvesting forbidden forests from the 17th century, over harvesting, deforestation, and natural disasters occurred frequently during Meiji Restoration and World War II and after World War II, when the economy grew rapidly. Today's forests have been established and maintained due to the constant efforts by people to restore the people's forests and warm and humid climate of Japan.

Most of the 200 species of terrestrial mammals and over 40 percent of approximately 8,800 species of ferns and seed plants are considered forest associated.

As for the forest ecosystems type, the proportion of forests where coniferous tree species are dominant and forests where broad-leaved tree species are dominant to the total forest area is almost same (50% and 44%, respectively), and there are various other types of forest ecosystems in Japan (Note: The dominant tree species is defined as a tree species that accounts for 30% or more of the total breast height cross section). From the results of the National Forest Inventory of Japan over the past 15 years, there has been no major change in the area by the forest ecosystem type. However, careful monitoring of the beech is required, since the survey found that beech growth depends on the regions: young trees are continuously observed over the past 15 years in some regions, while no young trees

were confirmed at the same period in other regions.

Figure ii: Composition of Forest Ecosystems by Dominant Tree Species

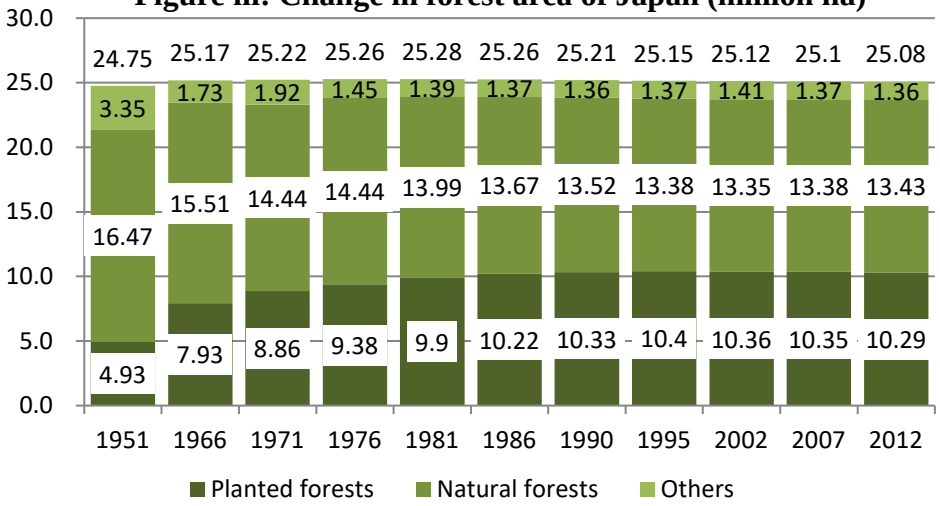


Source: Forestry Agency, National Forest Inventory of Japan (Third stage)

Approximately 54 percent of forests in Japan are classified as natural forests, according to the statistics of Forestry Agency of Japan. Some natural forests distributed in remote areas have preprimary forest ecosystems and fauna and flora. Other natural forests have been normally affected by human interventions, such as fuel wood production, commercial logging and enrichment plantation.

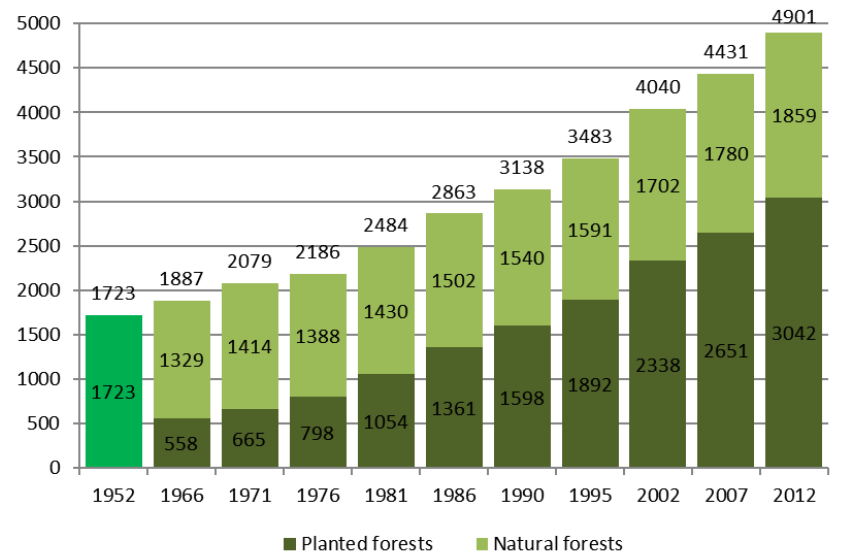
The forest stock has been increasing steadily, particularly in the planted forests. Japan's total growing stock is approximately 4.9 billion m^3, which accounts for about 2.6-fold stock in the 1960s.

Figure iii: Change in forest area of Japan (million ha)



Source: MAFF, Census of Agriculture and Forestry (for 1951 only); Forestry Agency, State of Forest Resources

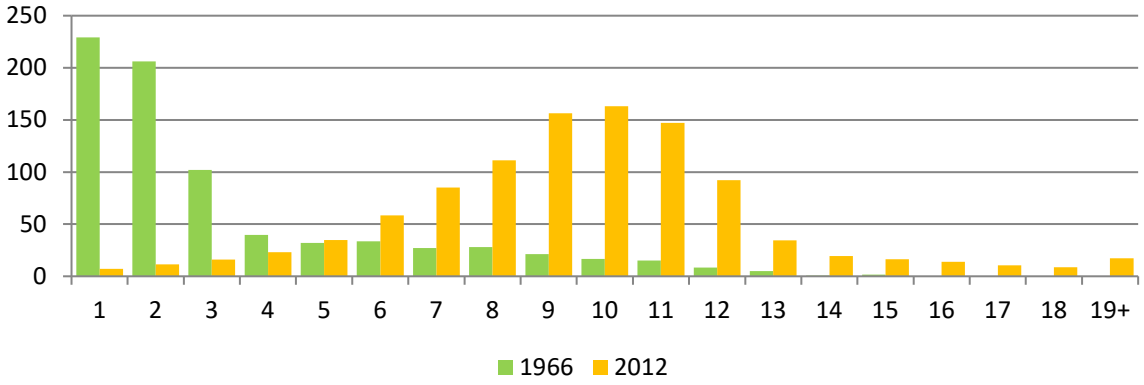
Figure iv: Change in the total growing stock of Japan's forests (million m^3)



Source: Forestry Agency. State of Forest Resources

The majority of the planted forests of Japan were established during the late 1950s through the early 1970s while wood demands for construction and pulp was increasing under the rapidly growing economy. Although there are still many forests that require thinning, more than 50% of the planted forests have reached higher than 50 years, which is a general harvesting age in Japan.

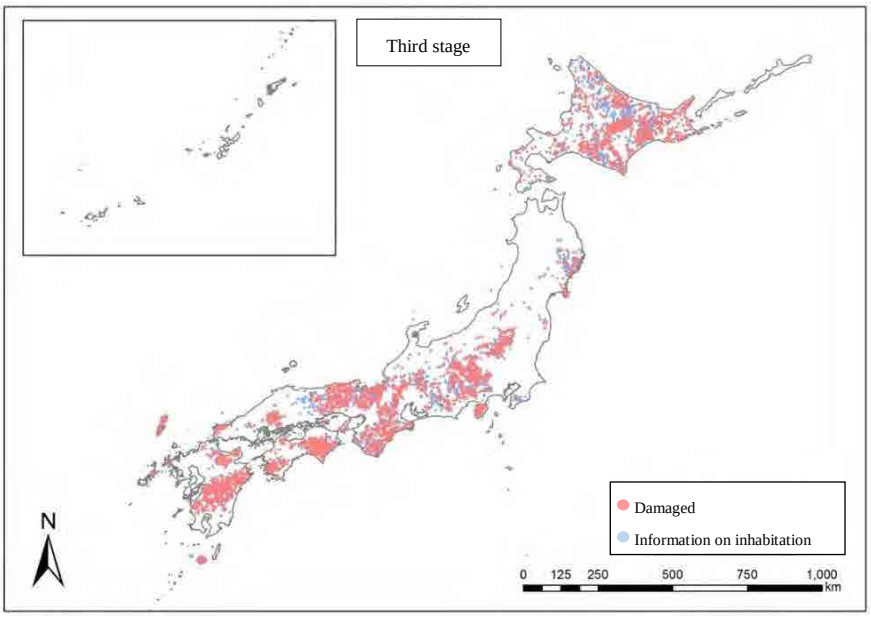
Figure v: Change in composition of age class of planted forests (10 thousand ha)



Source: Forestry Agency, State of Forest Resources

Although there are positive aspects in forest of Japan such as an increase in stocks, Japan encounters many issues on forest protection, such as damage of planted forests by wild animals, damage by Pine wilt disease and Japanese oak wilt, and invasion of bamboo species, etc.

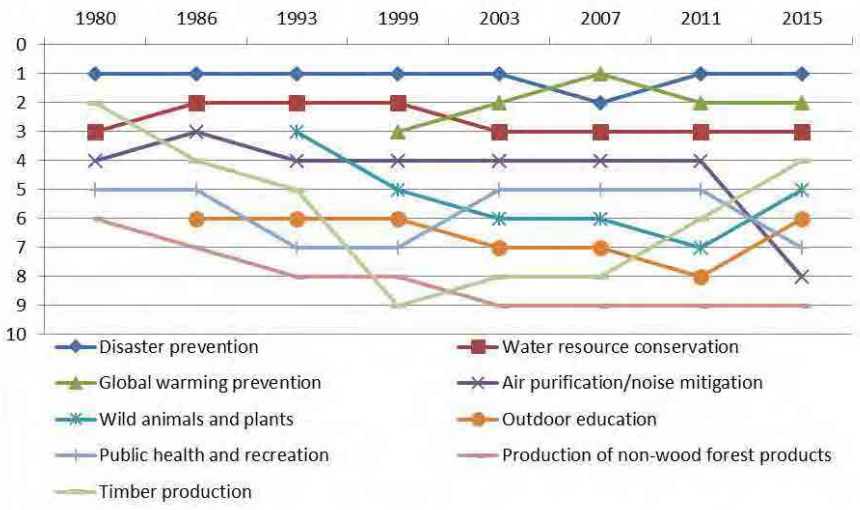
Figure vi: Distribution of plots that contain information on damages caused by deer or their habitation



Source: National Forest Inventory of Japan (Third stage)

Healthy and vital forests provide us socio-economic and environmental benefits. Recent years, with the increase of global environmental issues, people's expectancy on forests for disaster prevention, warming prevention and water resource conservation by forest occupy the top stably.

Figure vii: Change in public expectations on forests (ranking)



In addition, since Japan is surrounded by the seas and suffers frequent earthquakes due to the multiple tectonic plates in and around the territory, tsunami caused by these earthquakes gives severe damages at coastal area as well. The Tsunami occurred by the Great East Japan Earthquake in March 2011 took many people's lives. Coastal forests achieved a certain disaster reduction function against the tsunami and that led to re-evaluation of coastal forests. However, some coastal forests suffered devastating damage. Today, replantation of coastal forest is under operation with cooperation of the government and people.

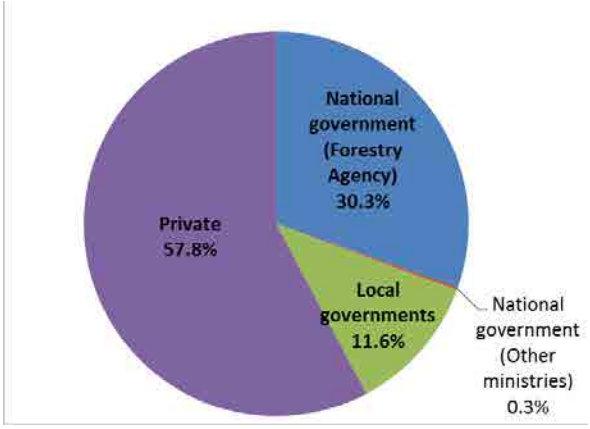
(1986), Poll on Forest and Greenery (1993) and Poll on Forest and Living (1999); Cabinet Office. Poll on Forest and Living (2003, 2007 and 2011); Ministry of Agriculture, Forestry and Fisheries. Survey on Awareness/Intension on Cyclic Use of Forest Resources (October 2015)

Photo i: Restoration of coastal forests (Motoyama town, Miyagi prefecture)

State of forestry

In Japan, 42% of forests are national forests and publicly-owned forests, and 58% are private forests. Among national and publicly-owned forests, 73% belong to the national government and the other 27% belong to local public entities including prefectural and municipal governments and communal districts.

Figure viii: Composition of forests by types of ownership



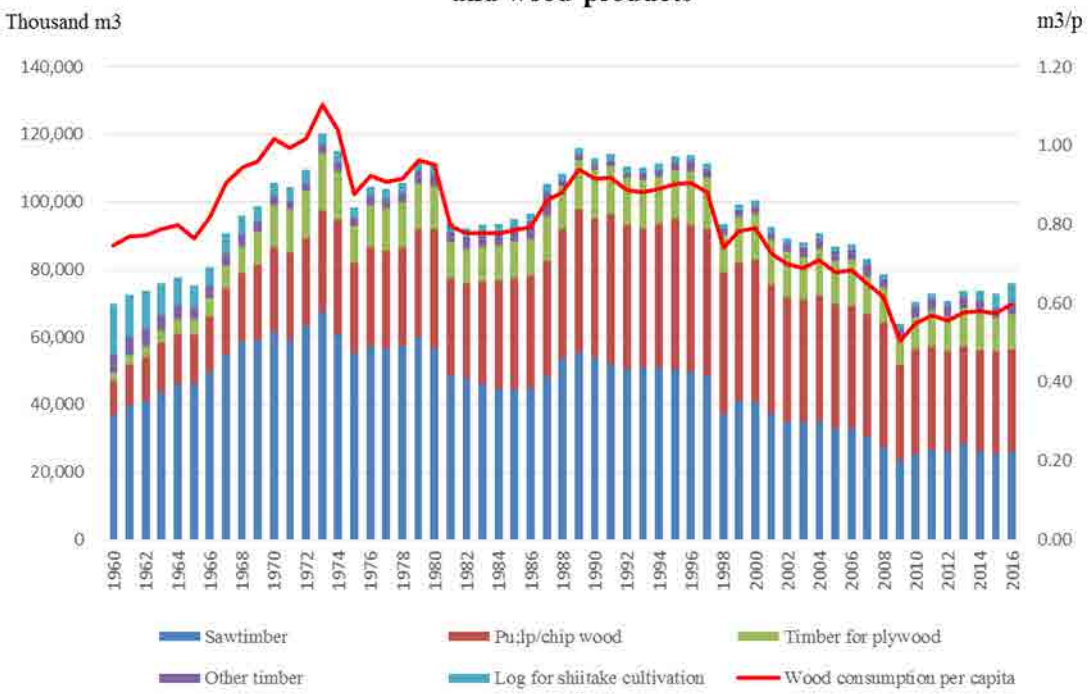
On the other hand, the most of private forests are owned by individual forest owners. According to the Census of Agriculture and Forestry 2015, scale of forests per forest owner or forest management entity is increasing while the number of forest owners who own equal or more than one hectare of forest is decreasing. This shows the slight increase of the portion of forest owners and forest management entity with the larger scale of forests.

However, small scale ownership is still the characteristic of ownership structure among private forests in Japan, considering the existence of forest owners, owning less than one hectare of forest, who are no longer the object of the census. (There were 1,450,000 of small scale owners according to the census in 1990.) This structure chokes off an efficient forest practices and aggressive forest management in combination with steep topography in general.

State of wood industry

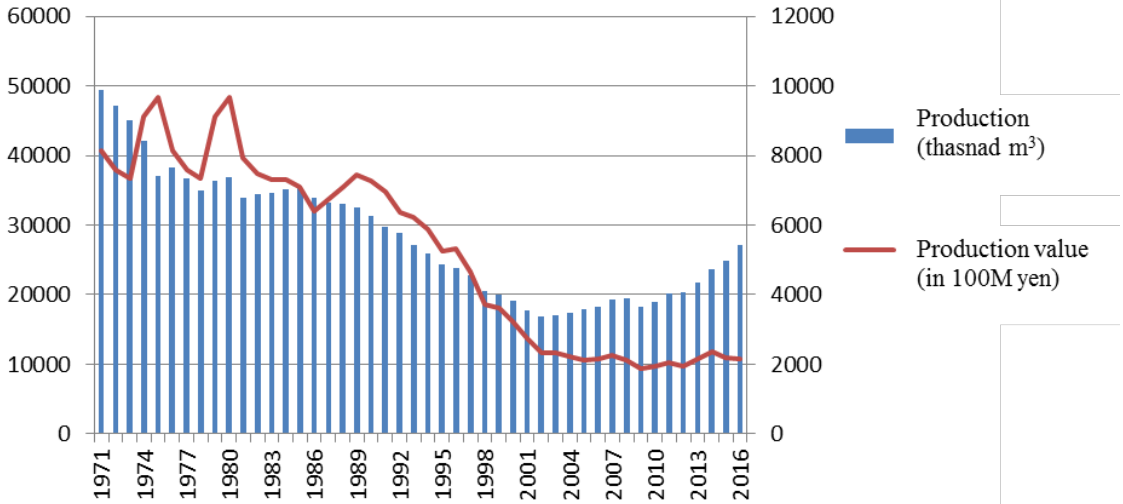
Recent years, wood demand in Japan generally continue to be below 80 million cubic meters in round wood equivalent. The demand is up swinging after it fell to 64 million cubic meters due to the financial crisis in 2009. Woods for pulps and chips accounts for the largest demand (40%), followed by for lumber (30%) and for plywood (10%).

Figureix: Change in Total and per capita consumption of wood and wood products



Sources: Forestry Agency. Wood Demand and Supply Chart; Ministry of Internal Affairs and Communication. National Census and Annual Report on Demographic Shifts

Figure x: Production volume and value of domestic logs



Source : Ministry of Agriculture, Forestry and Fisheries. Report on wood supply-demand and Lumber Statistics

Domestic wood production has recovered to 27 million cubic meters in 2016. 70% of total wood supply is covered by imported woods. While the share of imported log has been on a decreasing trend, the share of imported wood products has been on an increasing trend in recent years. Today, imported wood products shares 90 % of total imported woods.

Domestic wood production has been declined accompanied by a fluctuation since 1960s as a result of competition against imported logs and constructions materials other than woods. The progress of technology development in log processing accelerated this trend. For example, a small-diameter coniferous log produced by forest thinning turned out usable as plywood material and promotion of thinning in the first half of the 2000s. There are new movements such as enactment of the Act on Promotion of Use of Wood in Public Buildings in 2010 and production of cross laminated timbers (CLT), which enables timber use for large-scale public buildings.

Photo ii: Building using CLT (Kochi prefecture)

Photo iii: Wooden station building (Togoshi-ginza, Tokyo)

Woody biomass such as lumbering waste are recycled as raw material for paper and particle board, and combusted for heat utilization at a sawmill. In addition to these use, the biomass has been utilized as fuel for electric power selling under feed-in tariff scheme.

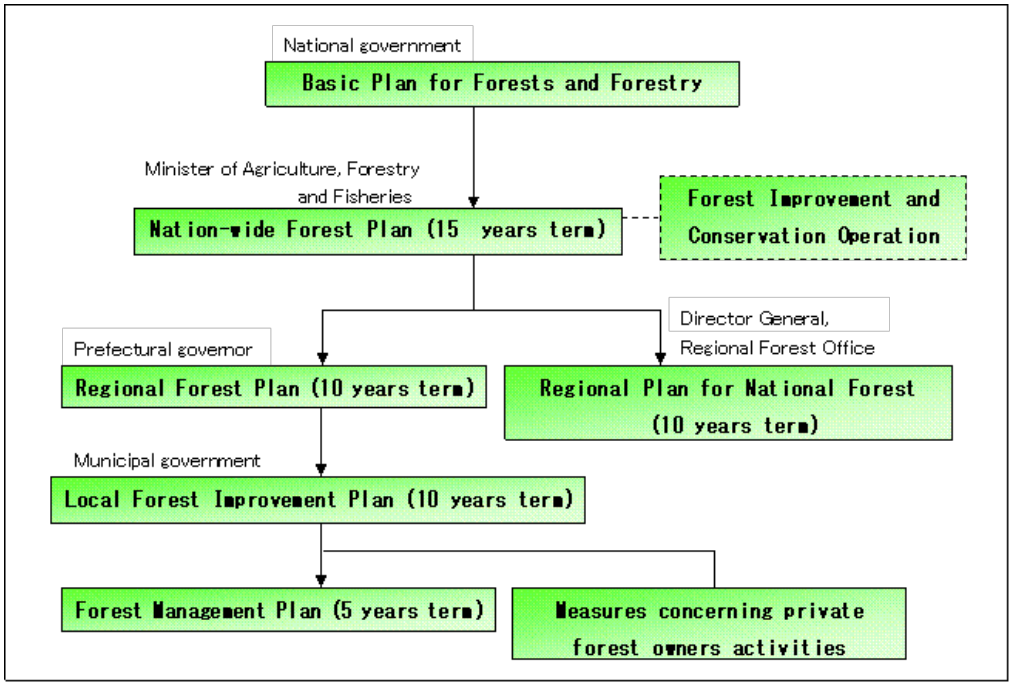
Forestry and wood industry which had been stagnant for long period are expected to play a big role in local economy once again with the background of matured planted forests. Since 2014, the government stated “Forestry as growing industry” as the most important political issue to promote timber use and to work increasing productivity and reducing production cost by introducing new technologies such as mechanization and use of ICTs.

Framework of Forest Administration

The principles of the management of Japan' forests are laid down by the Forests and Forestry Basic Act which was fully renovated in 2001 reflecting the international trends toward the sustainable forest management. The Act provides that the primary objective of the forest management is to sustain the multiple benefits from forests and defines, to this end, a range of policy measures to be implemented for the improvement and conservation of forests and the development of forestry and wood industry.

In accordance with the Basic Act, Basic Plan for Forests and Forestry has been periodically formulated (the latest plan was in May 2016) to identify Japan's national strategy containing long-term goals and approaches.

Figure xi: Structure of forest planning system of Japan



Sources: Forestry Agency

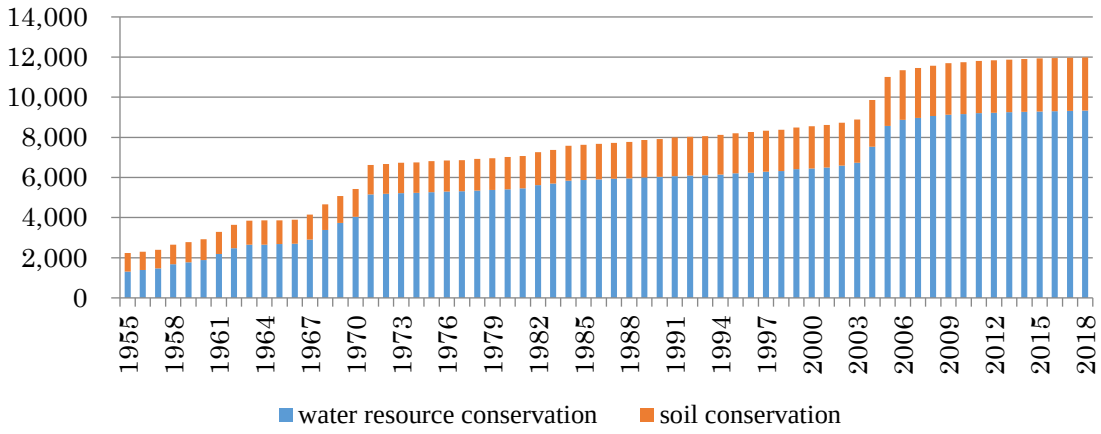
In order to implement a variety of policy measures, institutional frameworks, such as those for the forest planning and forest conservation, are provided by the Forest Act. Forest management plans are formulated at national, district and municipal levels by the respective government bodies and at the management unit level by the individual forest owners, as well, to ensure the sustainability of the resource base and the multiple functions of forests.

The protection forests are designated by the Minister for Agriculture, Forestry and Fisheries or the governor of prefectures for a variety of conservation needs, such as soil and water conservation and

recreational opportunities. Activities, such as logging operations and earthworks, are restricted in the protection forests depending on the purpose and the required level of conservation. The total area of protection forest accounts for 49% and 32% of forest area and national land area respectively as of 2016. Even in the forests other than protection forest, it is necessary to obtain permit from the prefectural governor in case of exploitation of one hectare or more forest land.

The instruction and assistance to the private forest owners and wood industry is carried out by both the national government, namely the Forestry Agency, and the prefectural and municipal governments in a coordinated manner.

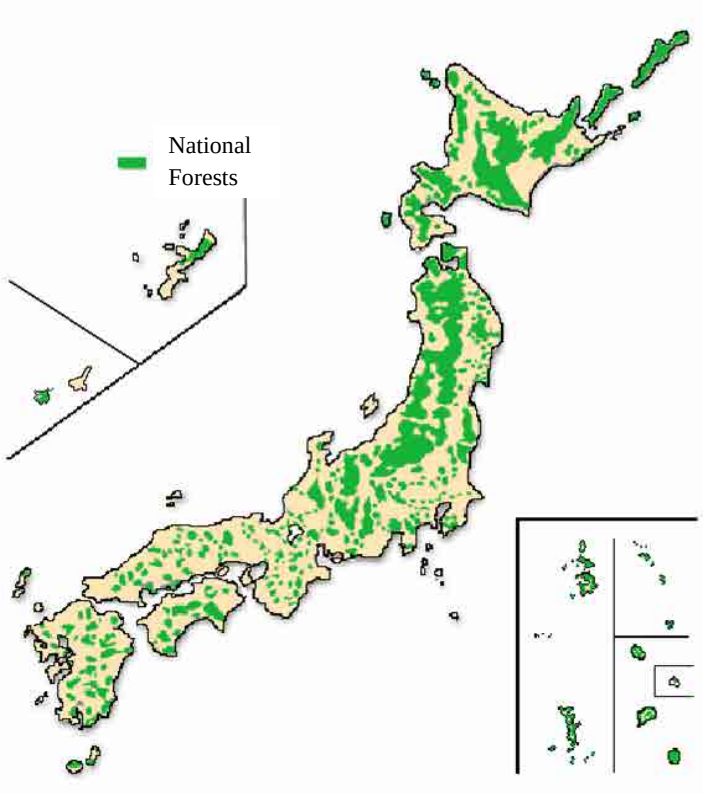
Figure xii: Change in areas of protection forests for soil and water resource conservation (1000ha)



Sources: Forestry Agency (Soil conservation shows the total area of protection forests for soil conservation while water resource conservation shows the total area of protection forests for headwater conservation and drought prevention)

The management of national forests, on the other hand, is directly conducted by the Forestry Agency, under which local offices, including seven Regional Forest Offices and 98 District Forest Offices, are distributed throughout Japan. National forest management system was modified to be operated under the general account of the government from special account in April 2013 so as to contribute to the revitalization of forest and forestry in Japan, as well as to further promote public-benefit-focused forest management. As transforming forestry into a growth industry has become an important policy of the government, it is expected to utilize technologies and experiences accumulated in national forest management operation.

Figure xiii: Distribution of national forests of Japan



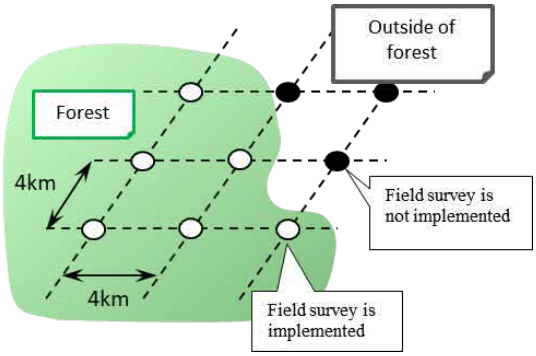
A variety of research and development activities related to forests and forest products are carried out collaboratively or solely by national, prefectural and private institutions and universities, including the Forestry and Forest Products Research Institute (FFPRI).

The newly developed stock seeds for planting are distributed by Forest Tree Breeding Center of FFPRI to prefectures and other organizations, and seeds are produced there for seed/seedling production by private sectors.

National Forest Inventory

The survey data of all the forests, including privately owned forests, have been compiled by compartment and reviewed in every five years on the occasion of the revision of the district forest plans. In 1999, the Forestry Agency introduced the National Forest Inventory (formerly called as forest resource monitoring survey) as NFI with the aim of supplementing conventional forest data, as well as providing data for MP reporting. A wide range of information, including vegetation and endangered species, is collected in the survey in every five years on approximately 13,000 sites at all grid points of 4km intervals. The result of the survey, which entered the fourth stage from 2014, is already utilized in this country report and the FRA2015 also.

Figure xiv: Structure of monitoring spot of NFI



Sources: Forestry Agency

Future Challenges

While the analysis on forest area based on ecosystem type says little change has been seen in recent 15 years, it is important to continuously grasp the real picture of whole forest in statistical methods so that the analysis of the influence of climate change on forest ecosystem would proceed and the results should be utilized for reviewing possible measures.

As transforming forestry into a growth industry has been regarded as one of the important policies of the government, there are positive signs in forestry and wood industry with the background of maturing forest resources and thus people's expectation on wood production function of forest is increasing. However, there remain many issues to be solved like cost-cutting of harvesting and planting activities.

Besides, proper forest management and conservation-related activities, as well as provision of disaster control facilities should be promoted properly against a backdrop of possible increase of torrential downpour due to climate change, to enhance protection and mitigation function from damages caused by mountain disasters.

As for mitigation measures for climate change, it is also important to ensure the function of forest as a carbon sink through forest management and conservation and that of CO2 storage and emission reduction through wood utilization.

The government of Japan recognizes that sufficient forest-related information such as roles of forest, forestry and wood industry and importance of them be provided for the better public understanding and that necessary measures be taken systematically and effectively with the participation of various stakeholders.

Introduction: About the Montréal Process

Development of the Montréal Process

Since the Earth Summit (UNCED) held in Rio de Janeiro in 1992, the promotion of sustainable forest management has become an internationally important challenge. In this context, initiatives to develop criteria and indicators as "measures" for objective monitoring of the sustainability of forest management have advanced in many regions in the world. FAO reports that there are nine criteria/indicator developing processes, including the process by tropical timber exporting countries that are members of International Tropical Timber Organization (ITTO), and that about 150 countries are participating in one or more processes.

The Montréal Process is an initiative to promote the development and application of criteria and indicators for conservation and sustainable management of temperate and boreal forests. Its 12 member countries are Argentina, Australia, Canada, Chile, China, Japan, Republic of Korea, Mexico, New Zealand, Russia, Uruguay, and the United States of America. The initiative is named after the venue of the expert seminar on sustainable forest management of temperate and boreal forests held in 1993 in Montreal, Canada, where discussion started. Since the Working Group was formed, in 1994, it has been working on the development and revision of criteria/indicators, collection of data based on the indicators, and development of country reports. Today the criteria and indicators of the Montréal Process consist of the following seven criteria and 54 indicators.

Criterion 1: *Conservation of biological diversity* (9 indicators, including the area of forests by forest ecosystem types and the number of forest-associated species)
Criterion 2: *Maintenance of productive capacity of forest ecosystems* (5 indicators, including the *area* and growing stock of forestland available for wood production, and area of plantations)
Criterion 3: Maintenance of forest health and vitality (2 indicators, including the area of forests affected by pests, fire, etc. beyond the normal range)
Criterion 4: Conservation and maintenance of soil and water resources (5 indicators, including the area of forests whose designation or land management focus is the protection of soil or water resources)
Criterion 5: Maintenance of forest contribution to global carbon cycles (3 indicators, including total forest ecosystem carbon pools and fluxes)
Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of society (20 indicators, including the percentage of recycling of forest products, and value of investment in the forest sector)
Criterion 7: Legal, institutional, and economic framework for forest conservation and sustainable management (10 indicators, including legal and policy frameworks, cross-sectoral coordination, and monitoring/assessment abilities)

The approach of criteria and indicators

In the Montreal Process, "criteria" are aspects of forests and forest management to be addressed in assessing the sustainability of forest management, while "indicators" are items on which measurements and information are collected to describe the state of forest and forest management along the criteria. Various discussions have been made on sustainable forest management in the international community also after the Earth Summit. The non-legally binding instrument on all types of *forests*[1] adopted at the UN General Assembly in December 2007 presented a concept of sustainable forest management "as a dynamic and evolving concept, aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations" (para. 4). It also states that the member states consider the seven thematic elements of sustainable forest management[2] as a reference framework for sustainable forest management and, in this context, identify, as appropriate, specific environmental and other forest-related aspects within those elements for consideration as criteria and indicators for sustainable forest management (para. 6(b)).

Individual criteria/indicator processes adopted their criteria and indicators for sustainable forest management based on the natural, social and other conditions of the regions but there are also international initiatives to standardize definitions of terms, harmonize reporting, and reduce the burden of reporting. For the development of the Global Forest Resources Assessment 2015[3] for example, C&I processes including Forest Europe, the Montreal Process, International Tropical Timber Organization (ITTO), and FAO cooperated to establish the Collaborative Forest Resources Questionnaire (CFRQ) Partnership.

The 2030 Agenda for Sustainable Development adopted at the United Nations Sustainable Development Summit in September 2015 set forth Sustainable Development Goals (SDGs) consisting of 17 goals and 169 targets for the international community to achieve by 2030. The agenda suggests that many of the 17 goals are related to the promotion of sustainable forest management. Goal 15 (terrestrial resources) incorporates targets such as the promotion of the implementation of sustainable forest management and increase of afforestation and reforestation globally. It has been agreed that the progress of SDGs will be measured using the indicators established for each

[1] UN General Assembly Resolution A/RES/62/98. Its formal name is Non-Legally Binding Instrument on All Types of Forests (NLBI). The *11th* Session of the UN Forum on Forests agreed on the resolution, including the change of the name to United Nations Forest Instrument (UNFI) (UN Economic and Social Council (ECOSOC) Resolution 2015/33. The revised UNFI was adopted by the UN General Assembly Resolution in February 2016 (A/RES/70/199).

[2] (a) Extent of forest resources, (b) Forest biological diversity, (c) Forest health and vitality, (d) Productive functions of forest resources, (e) Protective functions of forest resources, (f) Socio-economic functions of forests, (g) Legal, policy, and institutional framework

[3] Global Forest Resources Assessment (FRA) is a report compiled by the Food and Agriculture Organization using various statistics regarding forest and forestry of countries around the world. The report has been published once every five years since 1990.

target—232 indicators in total. The criteria and indicators of the Montreal Process will be useful also for the assessment of the progress of SDGs.

The criteria and indicators of the Montreal Process are an effort to assess the sustainability of forest management at the national or state level. There are also initiatives where third-party organizations certify forests at the management unit level based on certain criteria of the sustainability of forest management, consideration to environmental conservation, and other factors. The certification standards of the SGEC Certification Scheme[4] that was set up as Japan's unique private driven forest certification scheme are regarded as based on the indicators of the Montreal Process.

Operation of the Montreal Process

The Montreal Process is operated by the Working Group, which is the decision-making body consisting of the representatives of the member states, the Technical Advisory Committee, which studies technical issues based on the request of the Working Group, and the Secretariat for liaison and coordination of related parties.

The Working Group holds an annual meeting for which the member states take turns to provide the venue. The host country takes the chair.

The Canadian government served as the secretariat for the liaison and coordination of related parties from 1995 to 2006, but the Forestry Agency of Japan has been serving the office since 2007.

The Technical Advisory Committee consists of forestry experts of all member states. The committee collects data and provides the Working Group with technical and scientific advice on matters related to indicator measurement and reports.

Guiding Principles for Drafting the 3rd Country Report

There are various needs for international reporting concerning forest and forestry according to the purpose, which include country reports based on the Convention on Biological Diversity or the United Nations Framework Convention on Climate Change, Global Forest Resources Assessment (FRA), which was compiled and published by FAO based on forest and forestry statistics of individual countries, and voluntary country reports at the United Nations Forum on Forests (UNFF). It has become a challenge to ensure effective reporting while avoiding duplication. The Forest and Forestry Basic Act obliges the government to create Annual Report on *Forest and Forestry after consulting the Forestry Policy Council, and to submit the report to the Diet.* The report is uploaded on the website of the Forestry Agency. The abridged edition is translated into English.

The country report of the Montreal Process aims to analyze and explain the current state and challenges of Japan's forest, forestry and wood industry based on the seven criteria for sustainabile

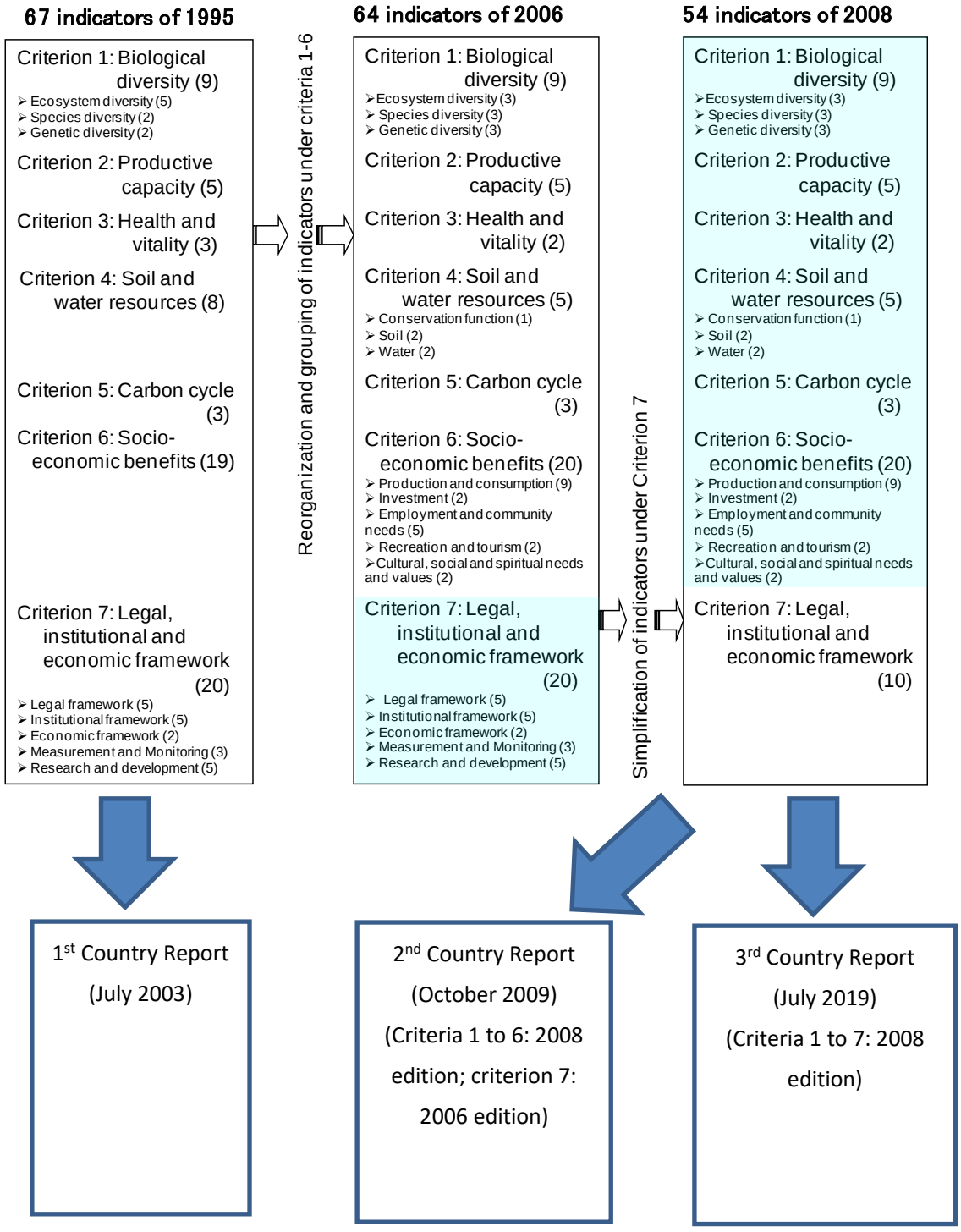
[4] The certification scheme implemented by Sustainable Green Ecosystem Council endorsed by Programme for the Endorsement of Forest Certification Schemes joined PEFC in 2014. The scheme and PEFC became mutually recognized in June 2016.

forest management by making the most of these existing data and information. Japan produced the 1st Country Report (only in Japanese) in 2003 and the 2nd Country Report (in Japanese and English) in 2009. This 3rd Country Report has developed a synthesis of trends of the changes in the circumstances surrounding Japan's forest and forestry after the compilation of the 2nd Country Report, based on the 54 indicators revised in 2009 and in the light of the revised Technical Notes on Implementation of the Montreal Process Criteria and Indicators, Criteria 1-7 (the 3rd edition) (hereinafter the "Note").

The report on each indicator consists of "Rationale" and "Current State and Trends." "Current State and Trends" basically make a report along the approach shown in the Rationale for better comparability of international data while at the same time describing conditions of the forest and forestry characteristics of Japan and high-priority policy challenges in the country wherever possible. For quantitative indicators, we have described medium- to long-term changes, factors behind them and other information that may serve as a useful reference wherever possible. As regards qualitative indicators, we have focused on especially important efforts and easy-to-understand cases to make them readily accessible to the readers.

The quantitative data we have used are basically official statistics of the Forestry Agency, but we have also used the results of the National Forest Inventory of Japan, which is a project conducted by the agency to continuously survey about 13,000 fixed plots across the country in a 5-year cycle (1st stage survey: 1999-2003; 2nd stage survey: 2004-2008; 3rd stage survey: 2009-2013).

Figure 1: Changes in criteria and indicators used for development of country reports



Criterion 1 Conservation of Biological Diversity

Forests, and particularly native forests, support a substantial proportion of the planet's biological diversity and terrestrial species. Biological diversity enables an ecosystem to respond to external influences, to recover after disturbance, and to maintain essential ecological processes.

Human activities and natural processes can impact adversely on biological diversity by altering and fragmenting habitats, introducing invasive species, or reducing the population or ranges of species. Conserving the diversity of organisms and their habitats supports forest ecosystems and their ability to function, reproduce, and remain productive.

1.1 ECOSYSTEM DIVERSITY

Maintenance of the variety and quality of forest ecosystems is necessary for the conservation of species. Without sufficient habitat size, adequate connectivity, necessary structural diversity and appropriate protection and management measures, species may decline and become vulnerable to extinction. These indicators provide information on the area and extent of ecosystem types, forest area under formal protection and the effects of fragmentation.

INDICATOR 1.1.a Area and percent of forest by forest ecosystem types, successional stage, age class and forest ownership or tenure

Rationale

This indicator provides information on the area and extent of forest ecosystem types, including successional stage,[5] age class[6] and the nature of tenure or ownership. The sustainability and stability of forest ecosystems may depend on their size and diversity. If these are not maintained, forests may become vulnerable to habitat degradation and loss. Tenures or ownership types may have a variety of management regimes associated with them – each with a different impact on biological diversity.

[5] ***Successional stage*** is the phase of the natural process observed in the vegetation, normally starting from bare land to matured forest.

[6] ***Age class*** is the grouped ages of stands by five years. In the case of planted forests, the ages of 1-5 years are classified as the 1st age class, the year 1 being the year of plantation, and the ages of 6-10 years are classified as the 2nd age class, and so on.

Current state and trend

(Distribution of Forests)

Japan has a narrow land area stretching over 3,000km from north to south, where boreal, cool temperate, warm temperate and sub-tropical forests are distributed along these climatic zones. Cool temperate forests are also distributed in high altitude areas in the western part of the Honshu island, Shikoku island and Kyushu district[7].

While the average annual rainfall is approximately 1,718mm, there is a wide variation depending on the area[8].

Figure 2: Vegetation map

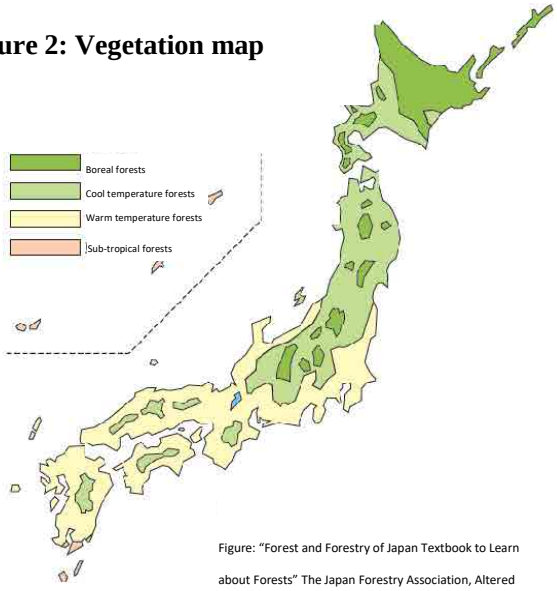


Figure: "Forest and Forestry of Japan Textbook to Learn about Forests" The Japan Forestry Association, Altered

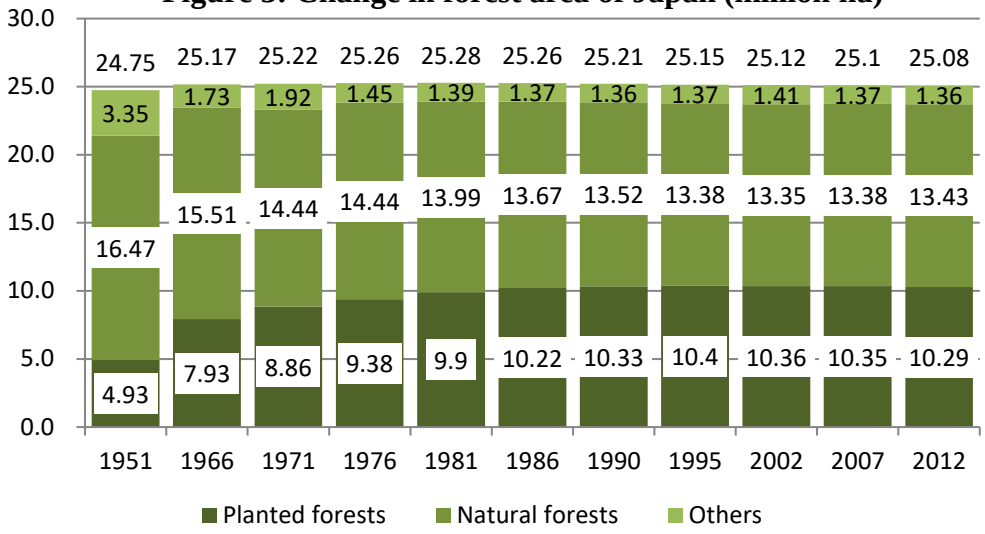
(Forest area)

The total area of Japan's forests is approximately 25 million ha, which corresponds to about two-thirds of the total land area. While the coverage of forests has been maintained for more than a half century, their composition has been changing. In 1951, the forest area was composed of approximately 20% of planted forests and approximately 70% of natural forests. In 2012, planted forests accounted for approximately 40% of the total forest area while natural forests accounted for approximately 50%. This change is mainly due to the active promotion of establishment of planted forests consisting of Japanese cedar or Japanese cypress, etc. from the late 1950s to around 1970.

[7] Forest and Forest Products Research Institute Cited from the "Guide for observing the tree garden" of Tama Forest Science Garden

[8] Based on the record at 1300 sites across the country from 1981 to 2015. Ministry of Land, Infrastructure, Transport and Tourism (2018) "Current State of Water Resources in Japan"

Figure 3: Change in forest area of Japan (million ha)



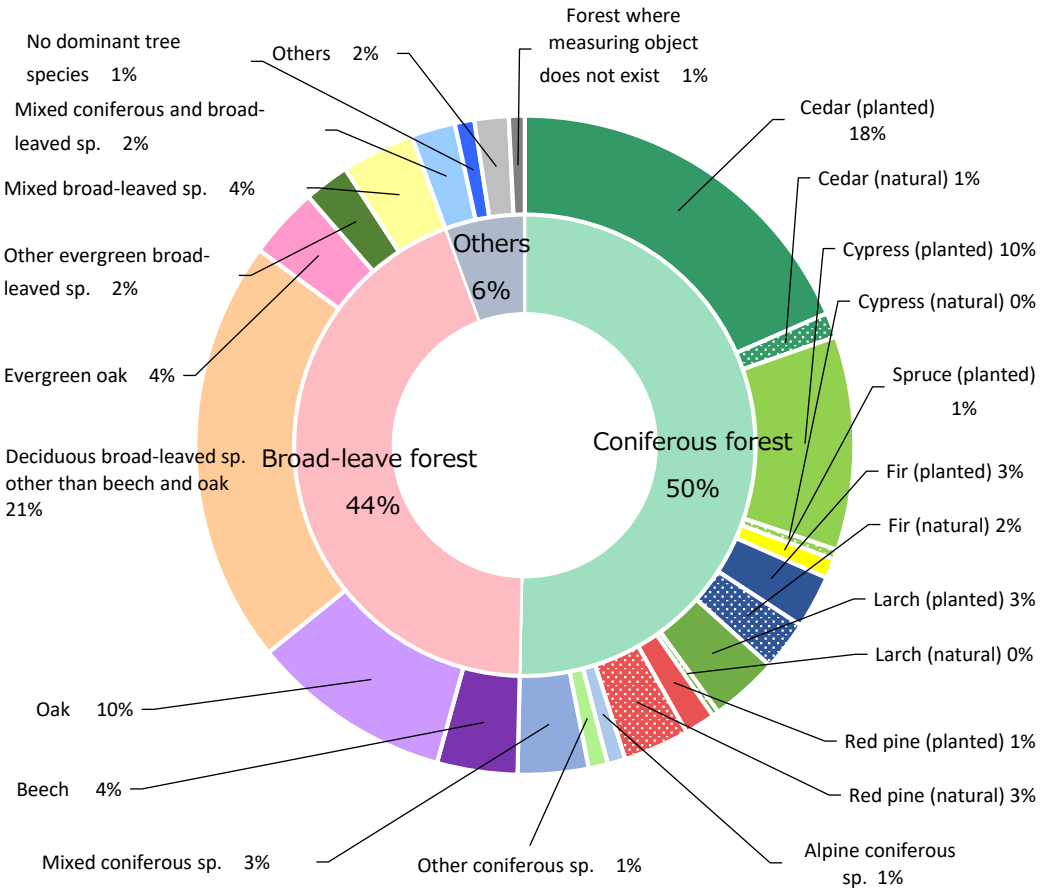
Source: MAFF, Census of Agriculture and Forestry (for 1951 only); Forestry Agency, State of Forest Resources

(Types of Forest Ecosystems)

According to the third stage of the National Forest Inventory of Japan (from 2009 to 2013)[9], the types of forest ecosystems in Japan were as follows: 50% of forests where coniferous tree species are dominant, 44% of forests where broad-leaved tree species are dominant, and 6% of other forests. Among them, coniferous forests are composed of 20% Japanese cedar (*Cryptomeria japonica*) and 10% Japanese cypress (*Chamaecyparis obtuse*); broad-leave forests are composed of 10% Japanese oaks (*Quercus spp.*) and 4% beech (*Fagus crenata*) and evergreen tree species among Japanese chinquapin and oak (*Castanopsis Quercus*).

[9] Since 1999, a nationwide survey has been implemented for 5 years as one cycle and the survey periods were as follows: the first stage was from 1999 to 2003, the second stage was from 2004 to 2008 and the third stage was from 2009 to 2013.

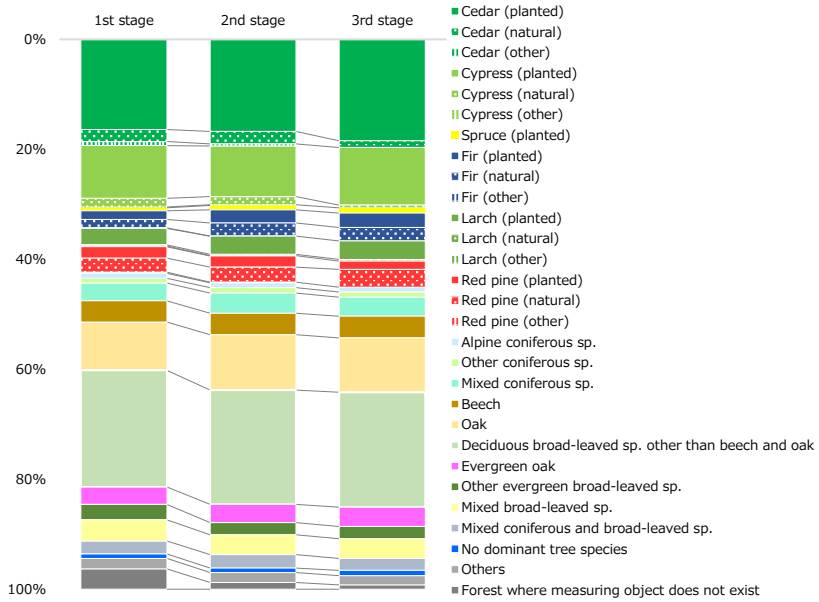
Figure 4: Composition of Forest Ecosystems by Dominant Tree Species



* Aggregated based on the dominant tree species, which are tree species occupying more than 30% of the total basal area of tree species that appear in the spot.

Source: Forestry Agency, National Forest Inventory of Japan (Third stage)

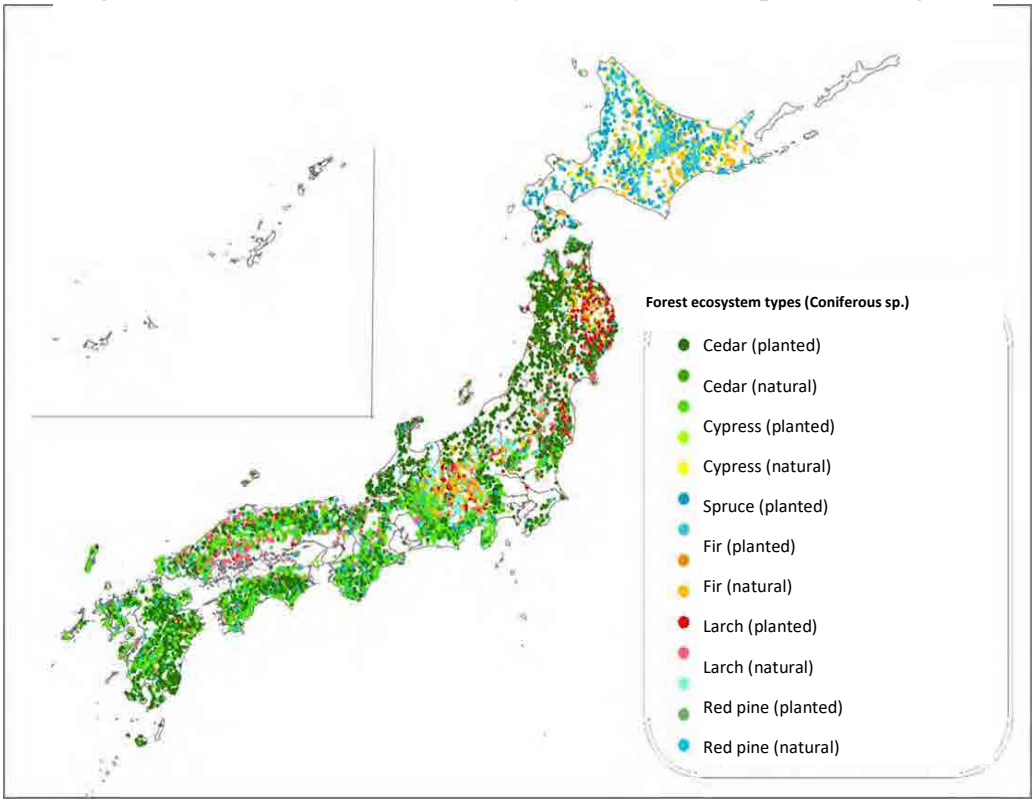
Figure 5: Change in Composition of Forest Ecosystem Types



*Classification for planted / natural forests and others is based on the forest inventory for the first and second stages, and on the ground survey for the third stage.

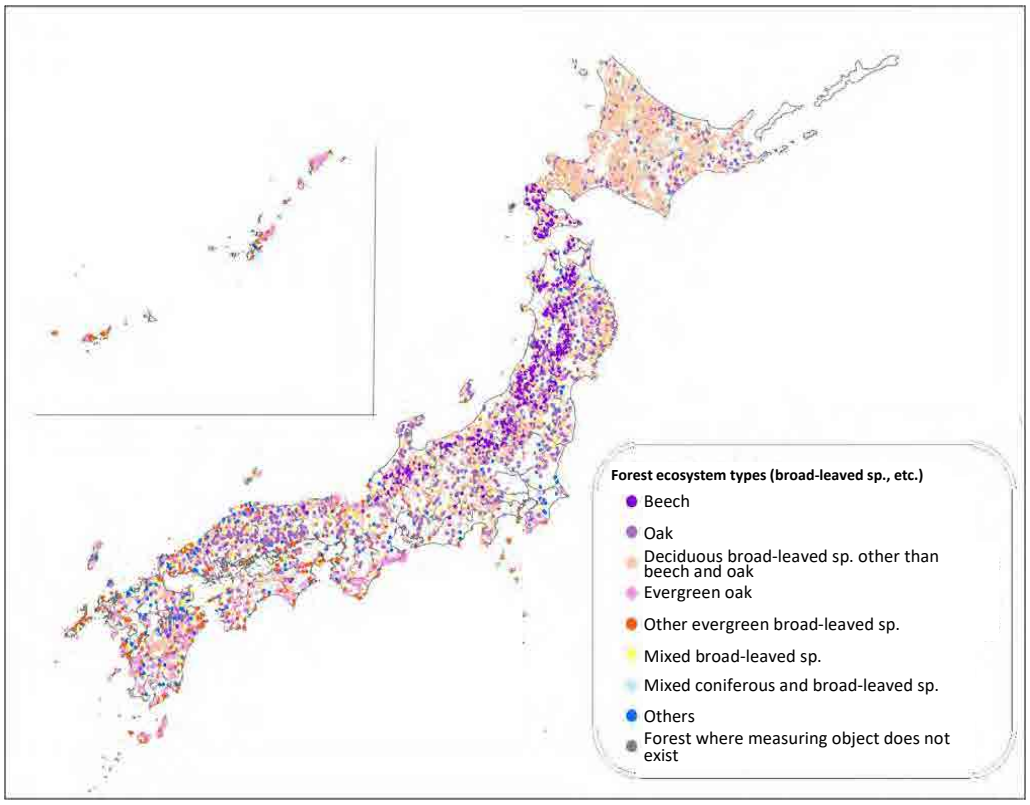
Source: Forestry Agency, National Forest Inventory of Japan (Surveys from first to third stages)

Figure 6: Distribution of Forest Ecosystems (Coniferous sp., Third Stage)



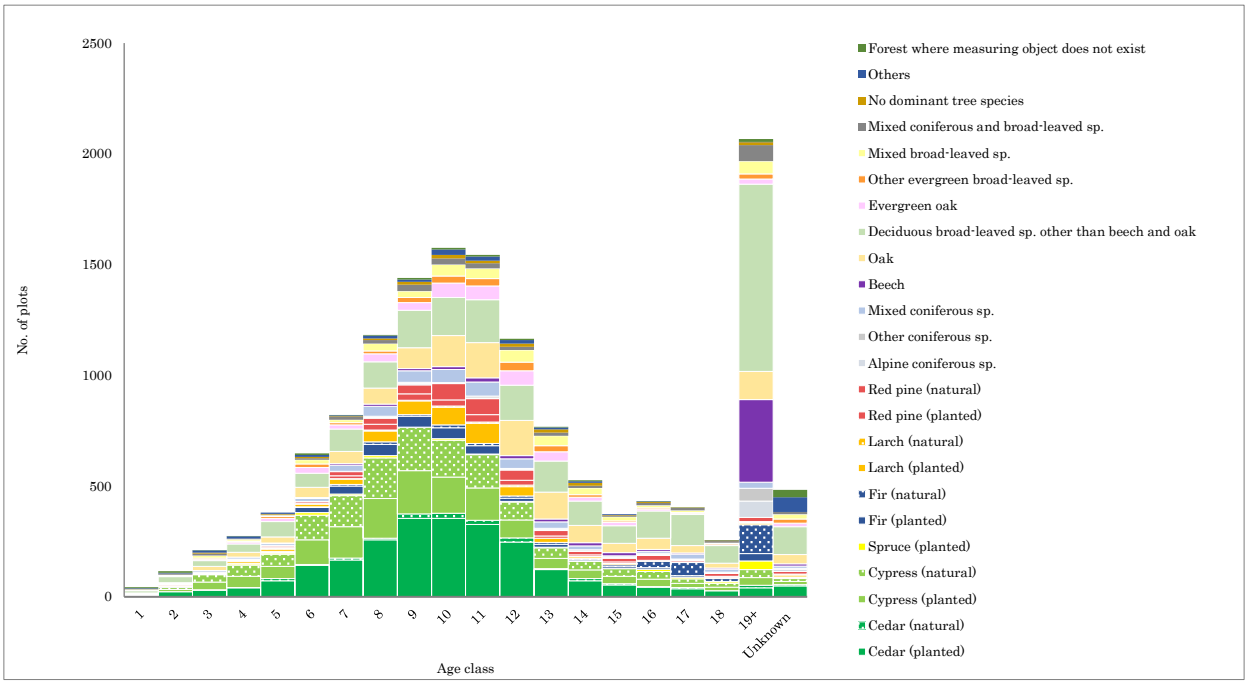
Source: Forestry Agency, National Forest Inventory of Japan (Third stage)

Figure 7: Distribution of Forest Ecosystems (Broad-leaved sp. and others, Third Stage)



Source: Forestry Agency, National Forest Inventory of Japan (Third stage)

Figure 8: Composition of Forest Ecosystems by Age Class

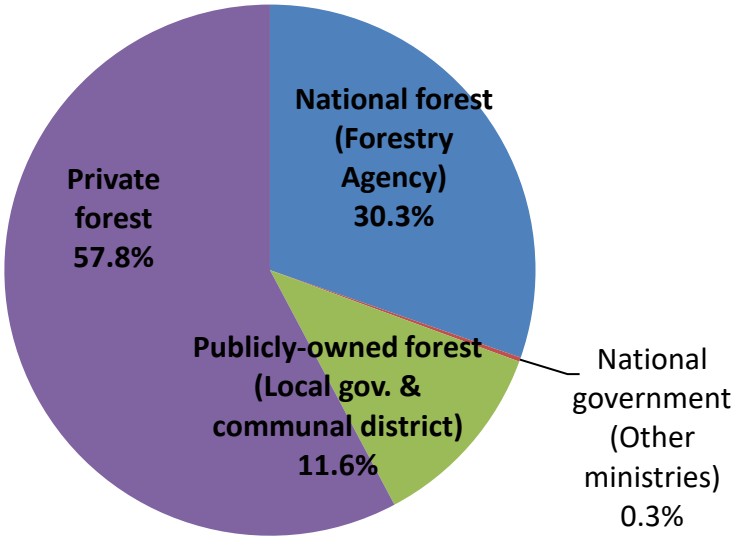


Source: Forestry Agency, National Forest Inventory of Japan (Third stage)

(Forest ownership patterns)

In Japan, approximately 58% of forests are private forest, 31% are national forest and 12% are publicly-owned forest. Publicly-owned forests belong to local public entities, including prefectural and municipal governments and the communal districts[10].

Figure 9: Composition of forests by types of ownership



Source: Forestry Agency, State of Forest Resources (2012)

[10] ***Forest owned by communal districts*** stipulated in the article 294 of the Local Autonomy Act. In case of municipal merger, communal districts are formed for forest used to be owned by community and/or old municipalities that are used and gotten earnings by local community.

INDICATOR 1.1.b Area and percent of forest in protected areas by forest ecosystem type, and by age class or successional stage

Rationale

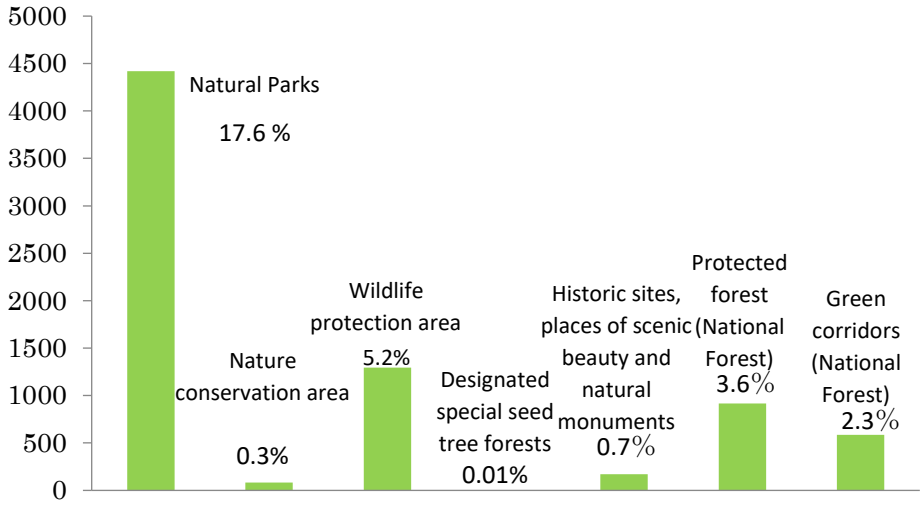
This indicator provides information on the area and extent of forest ecosystem type, age class or successional stage protected to safeguard biological diversity and representative examples of forest ecosystem types. This indicator will also help identify forest types of conservation value that are in need of protection. The level of formal protection given to forests is a reflection of the importance society places on their conservation.

Current state and trend

In Japan, forests protected for conserving forest ecosystems include the forests designated as follows: natural parks (Natural Parks Act), nature conservation area (Nature Conservation Law), wildlife protection area (Wildlife Protection, Control and Hunting Management Act), natural habitat protection area (Act on Conservation of Endangered Species of Wild Fauna and Flora)designated special seed tree forests (Forestry Seeds and Seedlings Act), Historic sites, places of scenic beauty and natural monuments (Act on Protection of Cultural Properties), protected forest and green corridors.

Aichi Biodiversity Target 11 under the Convention on Biological Diversity set a goal to conserve at least 17% of the terrestrial and inland water area through management of protected areas, etc. In this regard, Japan has reported in the Fifth National Report of the Convention on Biological Diversity that approximately 20.3% of the terrestrial and inland water areas are being conserved as protected areas.

Figure 10: Area of forests in protected areas (1000 ha, 2012)



Note 1: The areas of forest include overlapping areas.

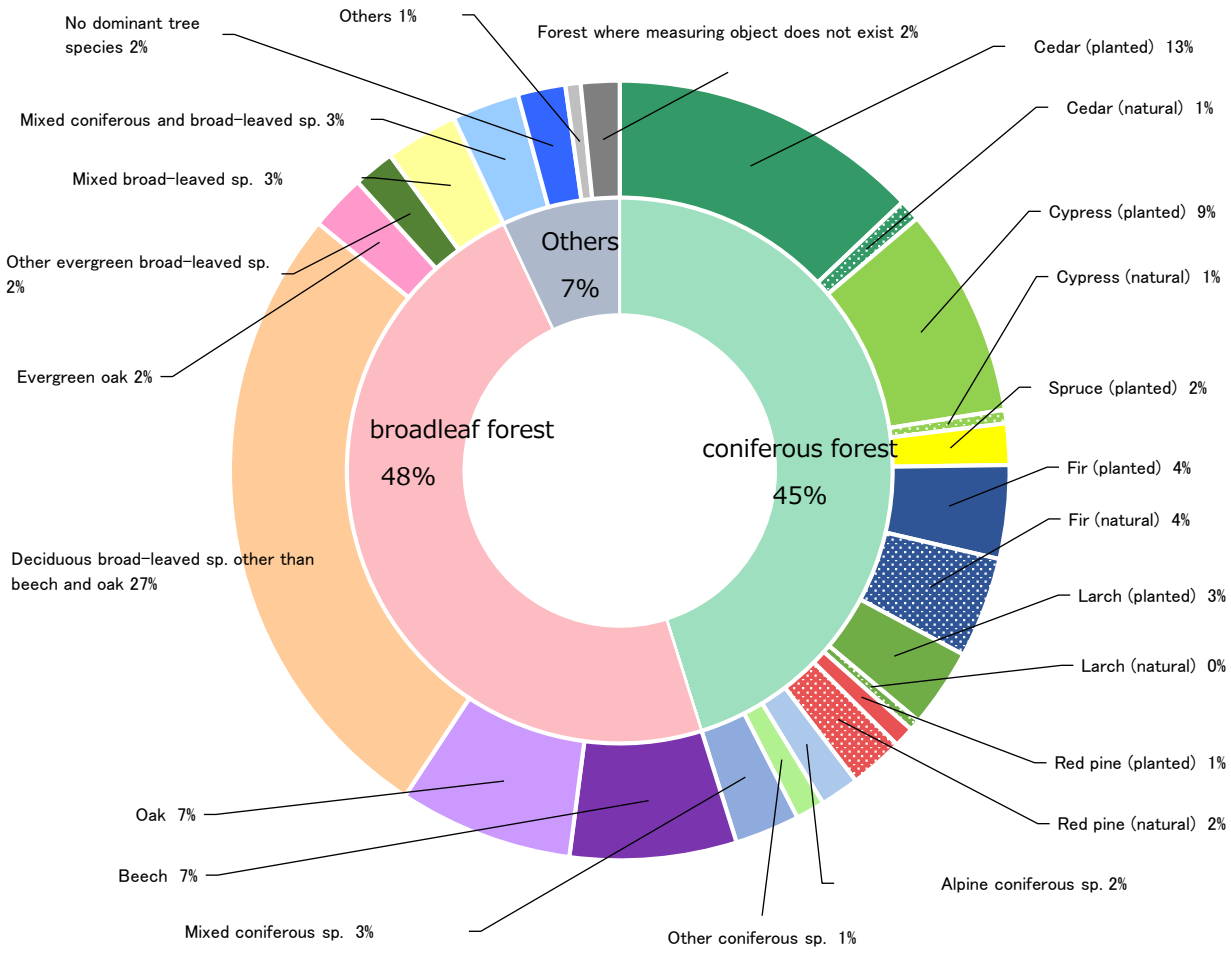
Note 2: The percentages represent the ratio to the total area of forests.

Source: Forestry Agency

(Forest Ecosystems)

According to the third stage of the National Forest Inventory of Japan, the forest ecosystems in protected areas were composed of 45% of forests where coniferous tree species are dominant, 48% of forests where broad-leaved tree species are dominant and 7% of other forests. Trends found in protected areas are similar to that of trends in the overall forests. For instance, planted coniferous forests accounted for 30% of the protected areas.

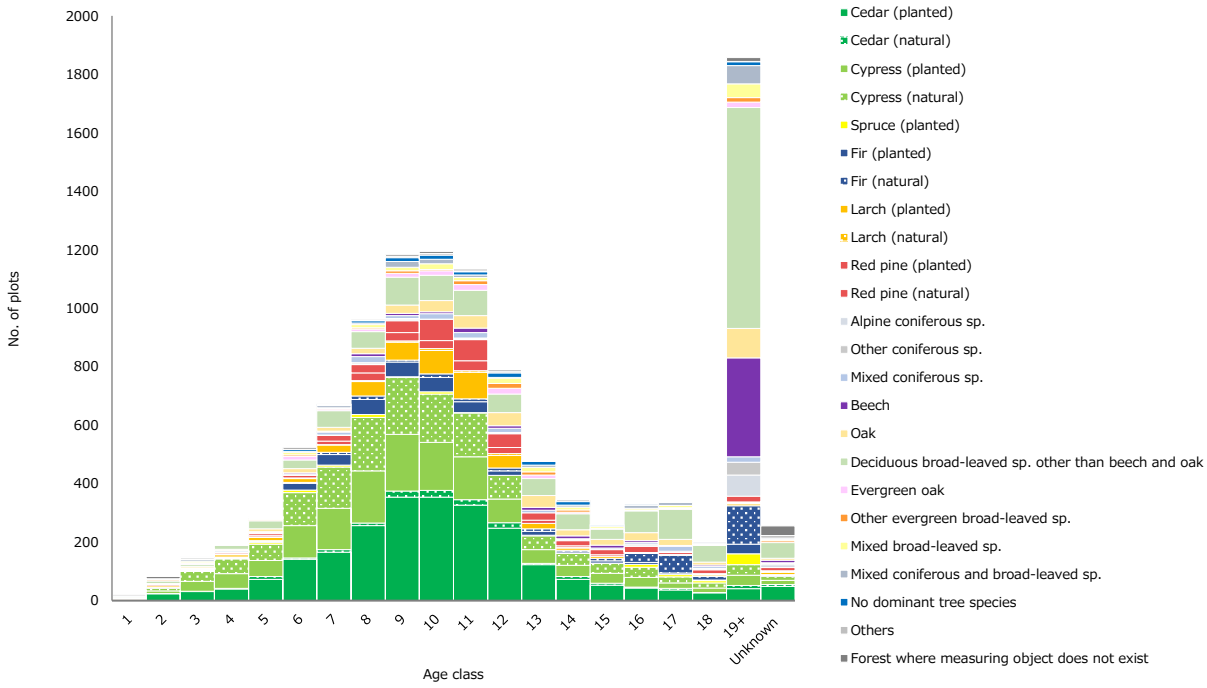
Figure 11: Composition of Forest Ecosystems by Dominant Tree Species in Protected Areas (Third Stage)



Source: Forestry Agency, National Forest Inventory of Japan (Third stage)

The counting method is the same as that applied for Indicator 1.1.a.

Figure 12: Composition of Forest Ecosystems by Age Class in Protected Areas (Third Stage)



Source: Forestry Agency, National Forest Inventory of Japan (Third stage)

INDICATOR 1.1.c Fragmentation of forests

Rationale

This indicator provides information on the extent to which forests are being fragmented over time by human induced activities and natural processes. Fragmentation may lead to the isolation and loss of species and gene pools, degraded habitat quality, and a reduction in the forest's ability to sustain the natural processes necessary to maintain ecosystem health.

Current State and Trends

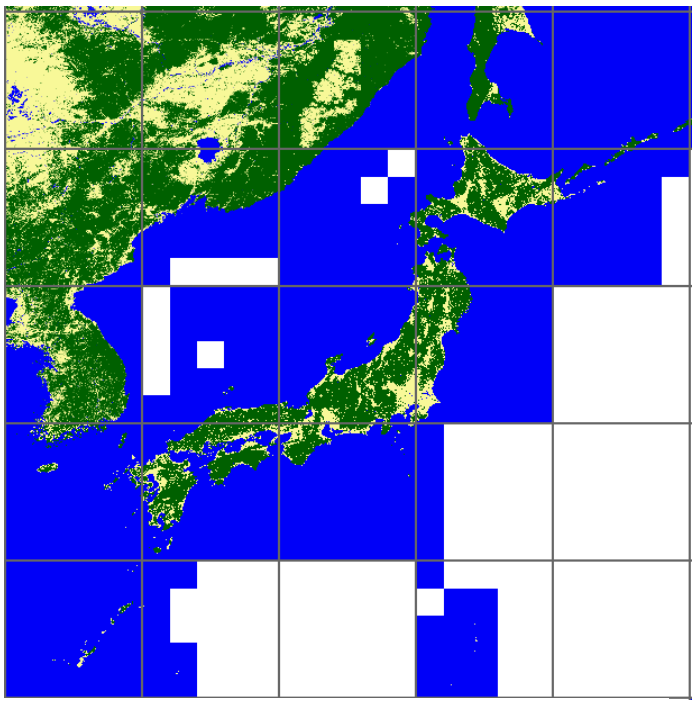
According to the Technical Note of the Montreal Process, this indicator is about the progress of fragmentation as a result of human induced activities in particular. The note points to the risk of natural disasters, including forest fires and storm winds, aggravating the forest fragmentation that is a result of human induced activities.

An example of human induced activities fragmenting forests is the development of farmlands or roads in forests. In Japan, the unregulated progress of forest fragmentation due to human induced activities is not anticipated because about 50% of forests are designated as protection forests, where changes to the form and nature of land are regulated. In forests other than protection forests, the development of land exceeding one hectare requires permission from the prefectural governor.

In this context, a 25 meter-resolution forest/non-forest map based on the global data obtained by using an L-band synthetic aperture radar mounted on Advanced Land Observing *Satellites of Japan Daichi (ALOS) and Daichi-2 (ALOS-2)* is downloadable from the website of JAXA, and the data of Japan has been published. Because a forest as a form of land use is defined regardless of whether there are trees or not, it may not be consistent with the interpretation result of satellite remote sensing, where the tree growing condition at the time of the photographing is visually determined.

The findings of studies on forest fragmentation (caused by farmland/housing land development) and genetic diversity of specific engendered tree species have been also published. As the latest forest fragmentation

Figure 13: 2017 forest/non-forest map



Source: Japan Aerospace Exploration Agency (JAXA)

data will be sequentially available, it is expected that specific research studies on genetic diversity will increase. Because it requires alternation of one or more generations for forest isolation to bring about an impact on the genetics of the natural population, it is necessary to pay attention that genetic decline due to forest fragmentation is not always detectable.[11]

[11] *Forest Genetics* and *Tree* Breeding, IDE Yuji, and SHIRAISHI Susumu, Bun-eido, P117

1.2 SPECIES DIVERSITY

The greatest and most readily recognisable aspect of biological diversity is the variety of species and their population levels. A key objective for the conservation of biological diversity is slowing down the rate of population decline, and species depletion and extinction due to human factors. Changes in species population levels and distribution may also provide an early warning of changes in ecosystem stability and resilience, as will increases in the number of invasive, exotic forest-associated species.

INDICATOR 1.2.a Number of native forest-associated species

Rationale

This indicator provides information on the health of forest ecosystems through the number of native forest-associated species.[12] Knowledge of the number of native forest- associated species highlights the importance of certain forest types in meeting conservation objectives and in understanding the relationships species have within ecosystems. The loss or addition of species in an ecosystem can provide valuable insights into the overall health and productivity of the system.

Current State and Trends

The third stage of the National Forest Inventory of Japan identified 2,970 native and 301 exotic vascular plants, 3,271 species in total. About 40% of about 8,800[13] vascular plant[14] species growing in Japan are thought to be forest-associated. They are classified into 1,200 woody, 2,065 grass, and 6 unclassifiable plants. In planted forests alone, 932 woody, 1,568 grass, and two unclassifiable plants have been identified. In Japan, planted forests also play an important role as the storehouse of many species for conservation of biological diversity.

The number of identified native and exotic species decreased in the third stage compared with the first and second stages. This may be greatly influenced by the change of the survey method, where the survey area to count the number of vascular plant species was reduced from the 1,000m^2 that is the entire plot to about 48m^2. It may be appropriate to use the survey results of the third stage for comparative analysis with the survey results of the fourth stage and after.

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[12] ***Native forest-associated species*** are species living in close association with forests in a variety of aspects, including habitats, food, nesting and breeding, among those which originally have habitats in Japan.

[13] Source: Table 4 The Number of Known Wildlife Species in Japan (material of the Central Environment Council on March 18, 2002)

[14] ***Vascular plants*** are the group of plants which have an organ known as a vascular bundle. Vascular plants, which include seed plants and ferns, are considered as a higher form compared to those which lack vascular bundle, such as bacteria, algae and moss plants.

Table 1: Number of vascular plant species growing in forests in Japan

	Numbers of identified vascular plant species		
	Native species	Exotic species	Total
The 3rd stage	2,970	301	3,271

(Reference)

	Numbers of identifies vascular plant species		
	Native species	Exotic species	Total
The 1st stage	3,632	368	4,000
The 2nd stage	3,558	437	3,995

Note: Understory vegetation was surveyed in the entire plot (1,000m^2) in the first and second stages, and a part of the plot (about 48m^2) was in the third stage.

Source: Forestry Agency. National Forest Inventory of Japan (1st to 3rd stages)

As regards animals, 133 species of mammals, 214 species of birds, 74 species of reptiles, and 50 species of amphibians are regarded as forest-associated according to the literature. Information on other animal and plant species is currently limited.

Table 2: Number of animal species living in forests in Japan

	Known species	Forest-associated native species
Mammals	185	133
Birds	417	214
Reptiles	97	74
Amphibians	64	50

Source: Report of kinetic change analysis project using the forest resource survey data of the Forestry Agency (March 2010)

INDICATOR 1.2.b Number and status of native forest-associated species at risk, as determined by legislation or scientific assessment

Rationale

This indicator provides information on the number and status of forest-associated species at risk or in serious decline. As a result, these species may require specific action or intervention to ensure their survival. The number of species at risk and their status is a measure of the health of forest ecosystems and their ability to support species diversity.

Current State and Trends

In Japan, the Ministry of the Environment assesses the extinction risk of individual wildlife species living in Japan from a biological perspective and compiles the results as Red List (list of endangered wildlife species).[15] According to the fourth Red List published in 2012, the number of endangered species[16] has increased in all categories, excluding mammals.

Since FY 2015 it was decided to revise the list individually as needed for species requiring reconsideration of the category (rank) due to deterioration of their living conditions, etc. The first to the third revised MOE Red Lists were published in 2015, 2017, and 2018, respectively. In the 2018 Red List the categories of 67 species were reviewed. As a result, the number of endangered species increased by 41 to 3,675 in total.

Japanese serow, which is a forest-associated native species, is found in Honshu, Shikoku, and Kyushu. Japanese serow in Kyushu and Shikoku were added to the Threatened Local Population (LP) in 2012 and 2015 Red List, respectively. Aging planted forests and decreasing food resources due to an increase of Japanese deer are pointed out as causes. It is found clear that the population size of Japanese serow is on a downward trend (the threatened local population is not included in the table below).

The number of Endangered Plant I (vascular plants) species was 1,779 in 2015.

Table 3: Number of Endangered Species in the MOE Red List (excerpt)

Plant I (vascular plants)	1,779	Amphibians	22
Plant II (bryophytes, etc.)	480	Brackish/fresh water fish	167
Mammals	33	Insects	358
Birds	97	Shellfish	563
Reptiles	36	Other invertebrate animals	61

Source: MOE Red List 2015

[15] Red List is a list of endangered wildlife species

[16] Endangered species are species with a high risk of extinction in the wild in the near future. They are divided into Critically endangered IA (CR), Endangered IB (EN), and Vulnerable II (VU).

The third stage of the National Forest Inventory of Japan identified 230 vascular plants listed in the Red List, including endangered and near-threatened species. One or more endangered or near-threatened species were found in 726 (5.4%) of the 13,380 survey plots.

Simple comparison of the number of the identified Red List species of the 1st and 2nd stages with that of the 3rd stage is inappropriate, because the survey areas of understory vegetation vary greatly. It would be appropriate to conduct the analysis again based on the survey results of 4th stage and subsequent stages.

Table 4: Number of identified plant species listed in Red List

Category		3rd stage
Endangered species	Critically endangered IA (CR)	16
	Endangered IB (EN)	41
	Vulnerable II (VU)	117
	Sub total	174
Near threatened (NT)		55
Data Deficient (DD)		1
Total		230

Reference: Number of identified plant species listed in Red List

Category		1st stage	2nd stage
Endangered species	Critically endangered IA (CR))	43	31
	Endangered IB (EN)	114	74
	Vulnerable II (VU)	176	169
	Sub total	333	274
Near threatened (NT)		41	84
Data Deficient (DD)		0	0
Total		374	358

※ The National Forest Inventory of Japan recorded the species identified through surveys of standing tree and surveys

※ Understory vegetation was surveyed in the entire plot (1,000m^2) in the first and second stages, and a part of the plot (about 48m^2) in the third stage.

※ The number of species in the first and second stage of the National Forest Inventory of Japan is based on the third Red List (published in 2010 and 2011), and the number of species in the third stage survey is based on the fourth Red List (published in 2012).

Source: Forestry Agency. National Forest Inventory of Japan (the 1st to the 3rd stage)

INDICATOR 1.2.c Status of on-site and off-site efforts focused on conservation of species diversity

Rationale

This indicator provides information that describes on-site (or *in situ)* and off-site (or *ex situ)* efforts to conserve species diversity. Some forest species and habitats may have declined to such an extent that intervention is required to safeguard them for the future.

Current State and Trends

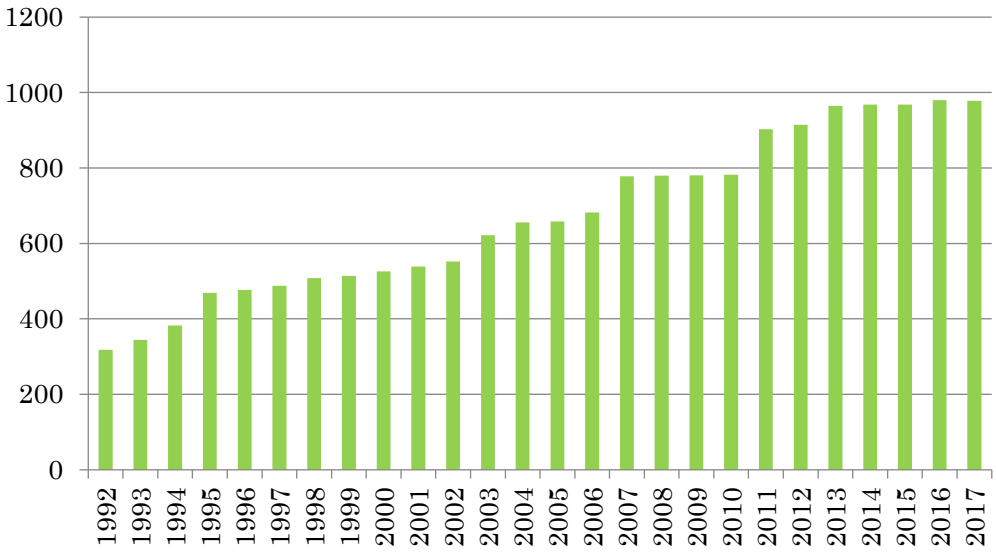
In order to conserve biological diversity, protected forests and green corridors are designated in national forests.

The aim of the protected forest system is to contribute to the protection of wildlife, conservation of genetic resources, etc. in primeval natural forests representing Japan’s climatic or forest zone, forests with a biocoenosis unique to the region, and forests necessary for the growth and inhabitation of rare wildlife species. In these protected forests, "adaptive management" is promoted to accurately assess changes in the condition of the forest ecosystem through monitoring and other means, and to review the management policy and designated areas as needed.

Green corridors are aimed at preserving forest ecosystems more broadly and effectively by connecting habitats of wild fauna and flora and securing migration pathways to encourage interaction among populations. Green corridors are set up to form networks connecting protected forests.

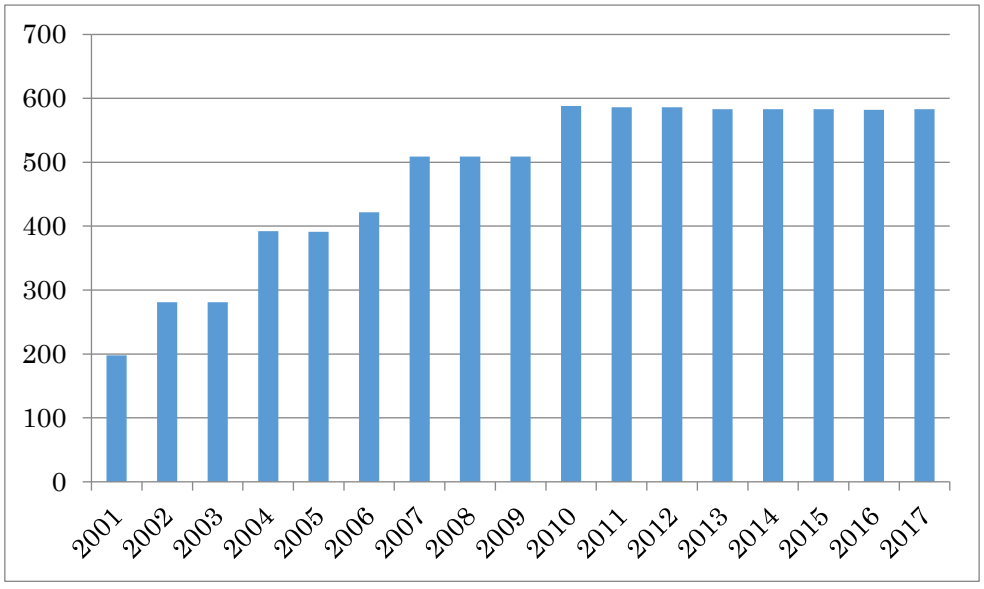
As of 2017, the area of protected forests is about 980,000 ha, or 4% of the total forest area of Japan. The area of Green Corridors is about 580,000 ha.

Figure 14: Change in the area of protected forests in national forests (1,000 ha)



Source: National Forest Management Statistics

Figure 15: Change in the area of Green Corridors in national forests (1,000 ha)

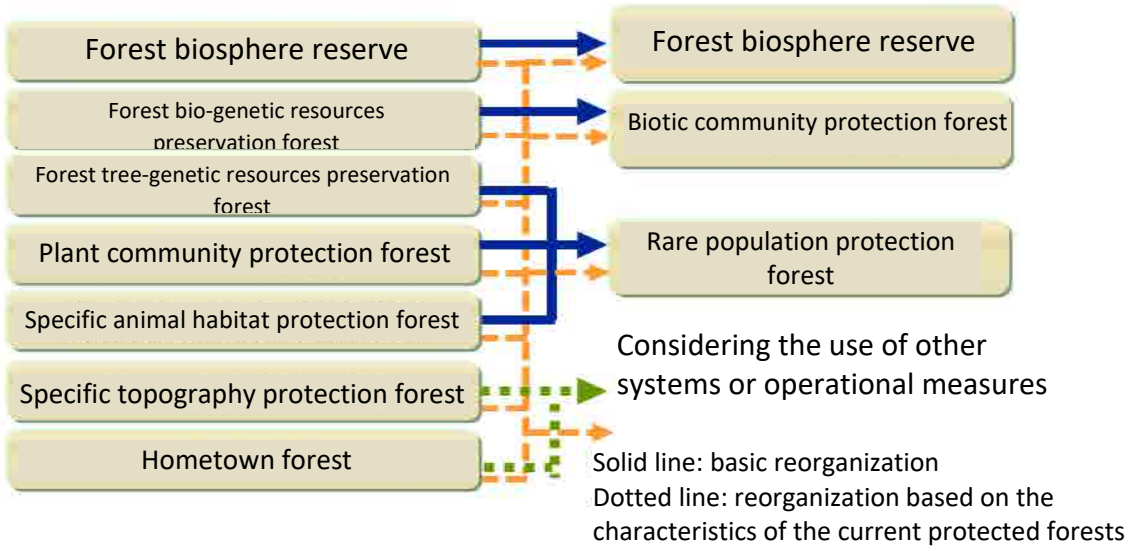


Source: National Forest Management Statistics

Protected forest system is a pioneering system to reserves in Japan and have fulfilled its role through reviews of the system in line with the times since their establishment in 1915. From 2015 to 2018, the system was reorganized in light of the growing public awareness of biodiversity conservation and accumulation of academic knowledge in recent years. Specifically, seven categories have been

reorganized into three for simplification, and an approach of long-term forest management practices to restore forests that have lost autonomous resilience has been introduced.

Figure 16: Review of protected forest categories



Source: Forestry Agency

In addition to the above, based on the provisions of the Acton Conservation of Endangered Species of Wild Fauna and Flora, when the survival of populations of a species designated as a nationally endangered species of wild fauna or flora is difficult just by regulating capture, collection, etc., and it is necessary to conserve their habitats, Natural Habitat Protection Areas are designated. As of March 2018, nine sites, 890ha in total are designated as Natural Habitat Protection Areas, which include ecosystems where forest is a major component.

1.3 GENETIC DIVERSITY

Genetic diversity, or the variation of genes within populations and species, is the ultimate source of Biological Diversity at all levels and is important for the functioning of healthy forest ecosystems. Threats to gene pools come from climate change, catastrophic events, and human induced activities and pressures.

Loss of genetic variation reduces the ability of species to adapt to environmental change and for society to maximise the potential benefits available from forest species, for example for medicines and other bio-resources. High levels of genetic diversity within populations are usually a measure of their greater potential for survival. The loss of genetic variation within species also makes forest ecosystems less resilient to change.

INDICATOR 1.3.a Number and geographic distribution of forest-associated species at risk of losing genetic variation and locally adapted genotypes

Rationale

This indicator provides information on the number and distribution of forest-associated species at risk of losing genetic variation across their population. This erosion in genetic variation makes species less able to adapt to environmental change and more vulnerable to extinction. Some local populations with unique gene pools may also risk being swamped by large populations introduced intentionally, by accident, or by natural processes.

Current State and Trends

The genetic structures of organisms greatly vary, even within the same species, depending on the region. In Japan research has been conducted on regional genetic variations of some widely distributed tree species. The analysis of the appearance of saplings of the species in the observation points, based on the results of the National Forest Inventory of Japan, is expected to contribute to the understanding of the geographical distribution of the tree species in peril of losing genetic diversity and genotypes.

Selecting Japanese beech from among the tree species whose geographical gene structure has been elucidated, the sustainability of the species, regional genetic types, and diversity was analyzed based on the basic genetic data and the change in appearance of saplings found by the National Forest Inventory of Japan. The results are as follows.

It has been clarified that the gene structures of Japanese beech on the Sea of Japan side, in the region from Kanto to the Kii Peninsula, and in Shikoku/Kyushu differ. The appearance of saplings [17] and

[17] Standing tree of less than 5cm in diameter at breast-height identified in the standing tree survey is defined as young tree.

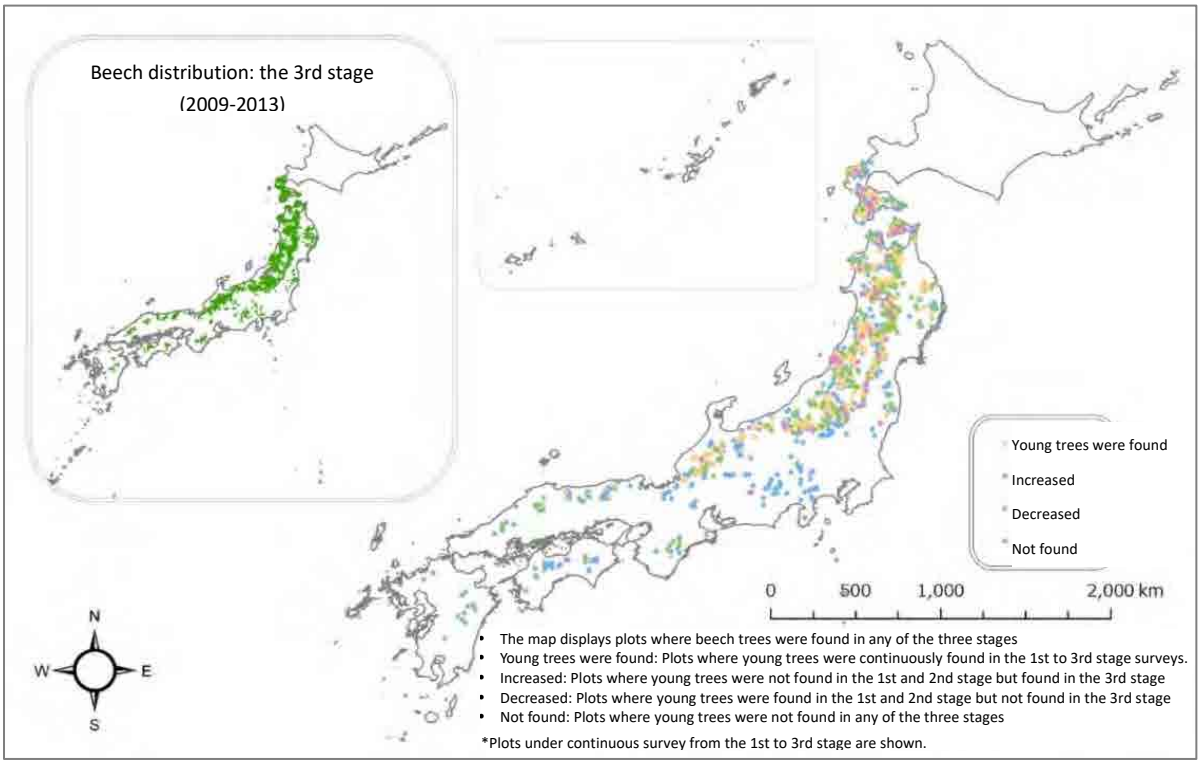
their changes in the first to the third stage of the National Forest Inventory of Japan were studied, classified as shown in the table below, and mapped in Figure 17.[18]

Category	Description
Saplings were found	Plots where saplings were continuously found in the 1st to 3rd stage surveys.
Saplings Increased	Plots where saplings were not found in the 1st and 2nd stage but found in the 3rd stage
Saplings Decreased	Plots where saplings were found in the 1st and 2nd stage but not found in the 3rd stage
Saplings Not found	Plots where saplings were not found from the 1st to the 3rd stage surveys

There were a large number of plots where “saplings were found" and "increased" on the Sea of Japan side of eastern Japan, but almost none in the region from Kanto to western Japan. It has been known that the gene structures of Japanese beech on the Sea of Japan side, in the region from Kanto to Kii Peninsula, and in Shikoku/Kyushu differ. The analysis shows that saplings are not stably found in the regions from Kanto to Kii Peninsula and Shikoku/Kyushu and suggests the possibility of poor regeneration. While it is known that isolation has progressed with high genetic diversity in western Japan, inferior renewal is observed in such area. The result may indicate the regions that require focused attention for sustainability.

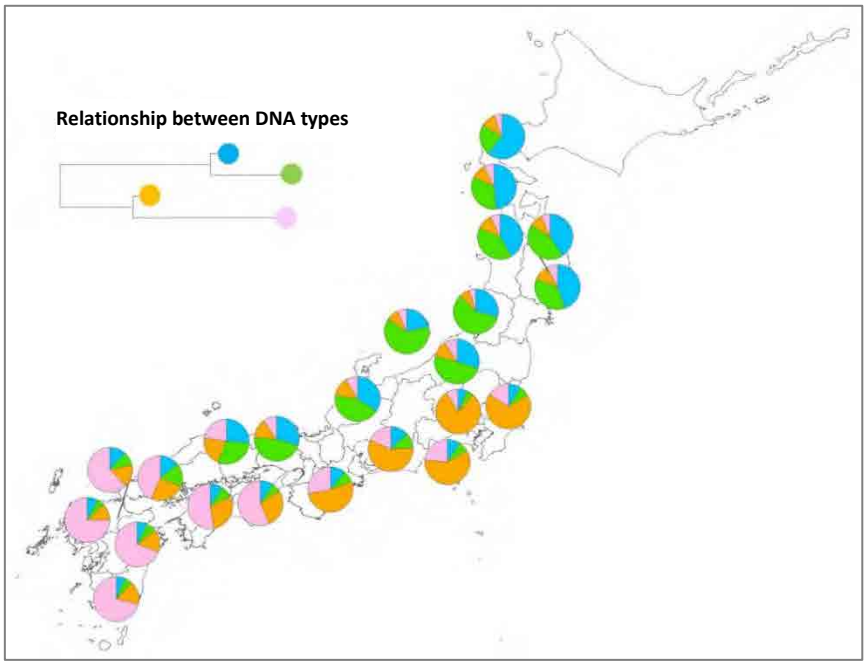
[18] In order to investigate changes during the survey period, only plots under continuous survey from the 1st to the 3rd stage were analyzed.

Figure 17: Japanese Beech distribution and appearance of saplings



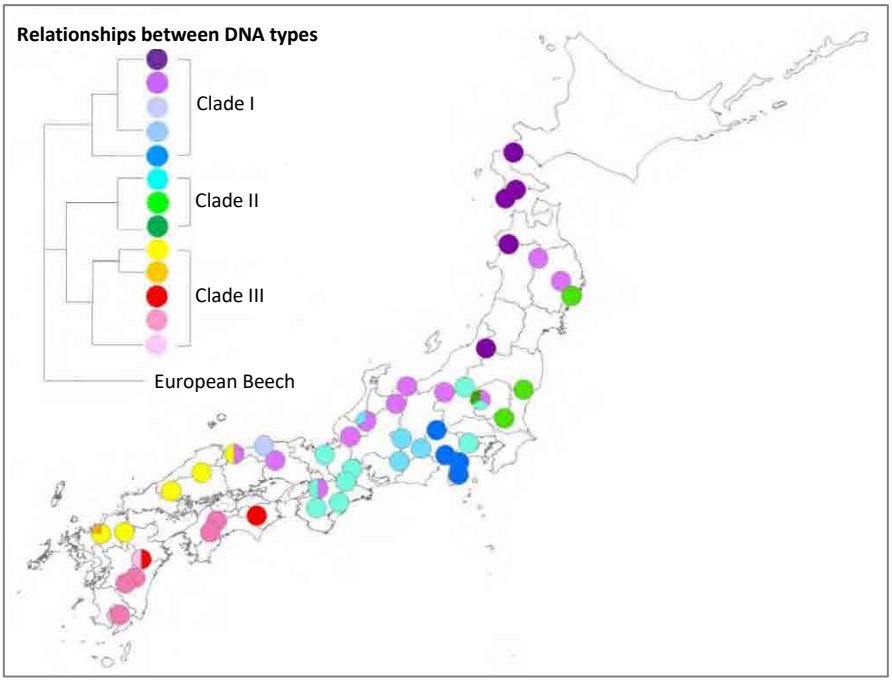
Source: Forestry Agency. National Forest Inventory of Japan (1st to 3rd stages)

Figure 18: Genetic population structure based on nuclear DNA analysis of Japanese beech



Source: Tsumura and Suyama (2015)[19]

Figure 19: Genetic population structure based on chloroplast DNA analysis of Japanese beech



Source: Tsumura and Suyama (2015)

[19] Tsumura Y and Suyama Y (2015), Seedling Transfer Guideline of Japanese Tree Species, p.176, ISBN-10: 482996524X, Bun-ichi Co Ltd, Tokyo (in Japanese)

INDICATOR 1.3.b Population status of selected representative forest species to describe genetic diversity

Rationale

This indicator provides information on the population status of forest-associated species that are considered to reflect the genetic diversity present in forest ecosystems. Some forest species support or highly rely on particular forest structure, patterns, associations, and functions, and can therefore be used to describe the status of genetic diversity in forests as a whole.

Current State and Trends

Information enough to identify the representative forest species reflecting the genetic diversity in forest ecosystems is not currently available in Japan.

As described in Indicator 1.3.a, studies have been conducted on the genetic diversity of some tree species in forests.

INDICATOR 1.3.c Status of on-site and off-site efforts focused on conservation of genetic diversity

Rationale

This indicator provides information that describes on site (or *in situ)* and off-site (or *ex situ)* efforts to conserve genetic diversity within species. Some species have suffered from a loss of genetic variability due to population decline and a reduction in their former range and distribution. Continued loss of genetic variability will threaten the viability of these species and may accelerate a decline that may lead ultimately to extinction.

Current State and Trends

The protected forest and green corridor in national forest, and other systems described in Indicator 1.2.c play a major role in the conservation of genetic diversity, as they do at the species level. The previous report included only the areas of forest bio-genetic resources preservation forests and forest tree-genetic resources preservation forests, but each of these forests have been reorganized into any of the current three categories as a result of the reorganization of the protected forest system described above. Forests of all these three categories are protected and managed as forests being to contribute to biological diversity, including intraspecific (genetic) diversity.

Green corridors mentioned in Indicator 1.2.c are aimed at conserving forest ecosystems more broadly and effectively by connecting the habitats of wild fauna and flora and securing migration pathways to encourage interaction among populations. Green corridors are set up to form networks connecting protected forests.

As of 2017, the area of protected forests is about 980,000 ha or 4% of the total forest area of Japan. The area of Green Corridors is about 580,000 ha.

In order to conserve the genetic diversity of forest-associated tree species, the Forest Tree Breeding Center has been conserving/preserving forest tree genetic resources in the various ways described below in consideration of the purpose of storage, including the securing of species diversity and intraspecific genetic diversity, local renewal status of genetic resources, and utilization of genetic resources.

・off-site conservation/preservation: about 26,000 adult organisms in the premises of the Forest Tree Breeding Center, etc., about 14,000 organisms of seeds, pollen or DNA in storage facility, and 932.34ha of 234 Preservation Stand (planted forests) as of the end of FY2016

・on-site conservation/preservation: 616.08ha of 53 Preservation Stand Forests (mainly natural forests) as of the end of FY2016

The Forestry and Forest Products Research Institute has been exploring, collecting, assessing, storing and distributing tree pathogenic microbes, wood rotting fungi, mycorrhizal fungi, and insect pathogenic microbes, which are genetic resources related to forests and forestry. Collected microorganism resources are identified by researchers specialized in the respective fields, and their characteristics are investigated. Identified strains are, after confirmation of their proliferation, stored and maintained in a stable condition, and distributed to research institutes and other organizations that use them for test research or education on mushrooms.

Criterion 2 - Maintenance of productive capacity of forest ecosystems

Many communities depend on forests directly or indirectly for a wide range of forest-based goods and services. The sustainable provision of these services is clearly linked to the productive capacity of the forests. If this capacity is exceeded there is the risk of ecosystem decline and collapse.

For forests to be sustainable it is necessary to understand the levels at which goods and services may be extracted or used without undermining the functioning of forest ecosystems and processes. The nature of goods and services provided by forests change over time due to social and economic trends, and technological developments. Change in the productive capacity of forests may be a signal of unsound forest management practices or other agents that are affecting forest ecosystems in some way.

INDICATOR 2.a Area and percent of forest land and net area of forest land available for wood production

Rationale

This indicator measures the availability of forest land for wood production compared with the total forest area of a country. It provides information that will help assess the capacity of forests to produce wood to meet society's needs.

Current state and trend

In Japan, forests where logging is prohibited in principle by laws and regulations are as follows: a part of protection forests designated under the Forest Act, forests located within the special protection zone of the natural park designated under the Natural Parks Law, the nature conservation area designated under the Nature Conservation Law and special seed tree forests designated under the Forestry Seeds and Seedlings Act. These forests account for about one to two percent of the total forest area. Regarding the protection forests, logging method and limitations must be established while designating the area under the Forest Act. Among these protection forests which are highly likely to suffer from soil run-off or landslide, rock-fall or avalanche due to logging are prohibited in principle. There are approximately 340,000 ha of such protection forests (as of the end of March 2018).

Forests other than mentioned above are allowed to produce timber under certain rules and guidelines, which is to secure fulfillment of the multiple functions of forests. In addition, there is 14 types of areas, such as soil erosion control area or special protection zone in the wildlife protection area, stipulated under Article 10 of the Regulation for Enforcement of the Forest Act. In the areas, the following requirements are prescribed for logging: (i) the logging must be conducted by thinning in principle, (ii) the logging must not conducted to the forests lower than the standard logging age; and (iii)

permission by the administrative agency must be acquired in advance to conduct logging. Also, notification must be submitted to the relevant mayor of the municipality prior to logging pursuant to the Forest Act.

INDICATOR 2.b Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production

Rationale

This indicator measures the growing stock[20] and annual increment of forest areas available for wood production to meet society's needs. The annual increment and growing stock can be related to the volume harvested each year so as to provide a means to demonstrate the sustainable management of forest resources.

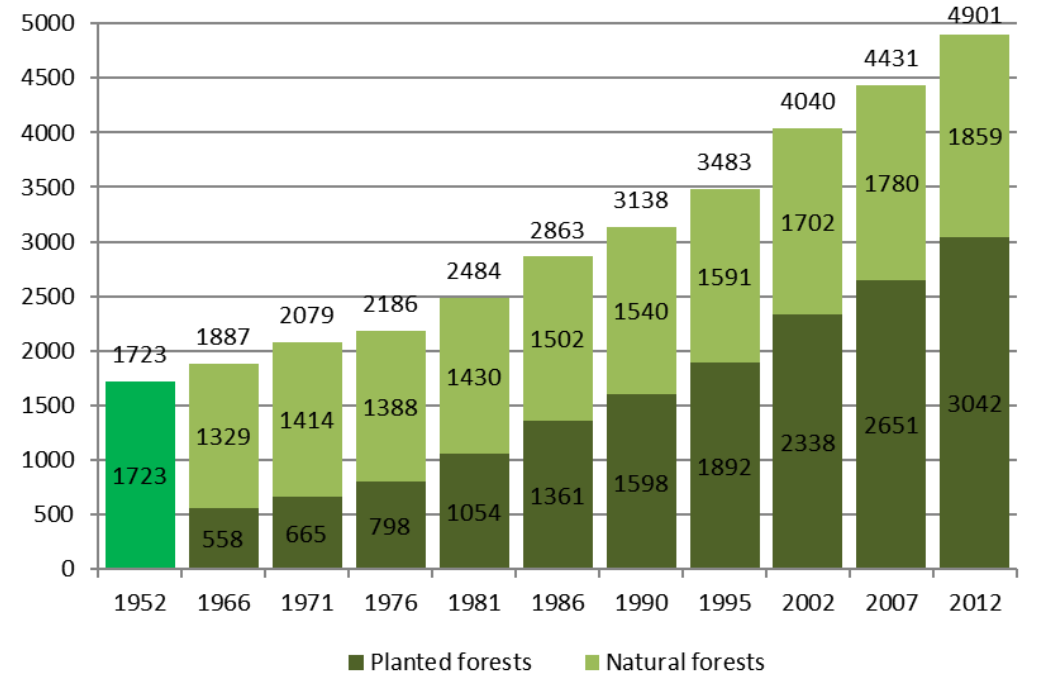
Current State and Trends

Japan's total growing stock has increased 2.6-fold, from 1.887 billion to 4.901 billion m^3, in the nearly half-century period from 1966 to 2012. Since 1990 the stock has been increasing at an annual average of about 80 million m^3.

The increase of the planted forest stock is particularly remarkable. It increased 5.5-fold, from 558 million m^3 in 1966 to 3,042 million m^3 in 2012. Its ratio to the total growing stock also increased from 30% to 62% during the same period.

[20] ***Growing stock*** is the volume of the stems of standing trees in forests.

Figure20: Change in the total growing stock of Japan's forests (million m³)



Note 1: Values as of March 31 of each year since 1966

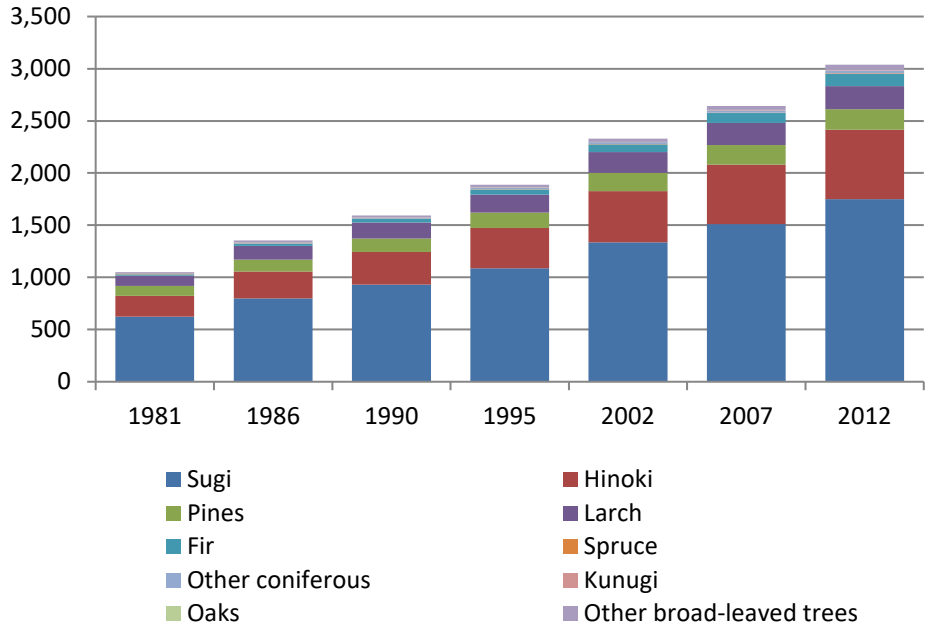
Note 2: Simple comparison with the values of 2007 and 2012 is not possible because prefectures tried to improve accuracy by reviewing yield tables, for example.

Source: Forestry Agency. State of Forest Resources

As regards the composition of species in growing stock of planted forests, *sugi* (*Cryptomeria japonica*) accounts for the largest part, followed by *hinoki* (*Chamaecyparis obtusa*). They are Japan's indigenous forest species that have been used for planting from old times and that are also widely used for commercial purposes, including building material thanks to their straight shape, good workability, and relatively rapid growth.

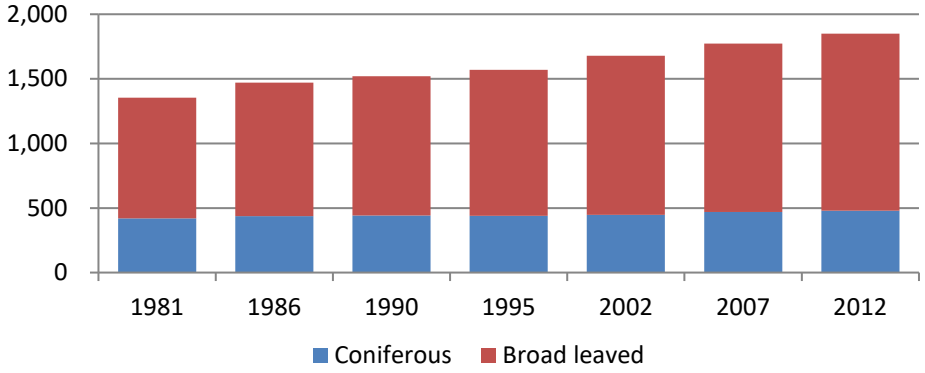
The growing stock of natural forests, mostly consisting of broad-leaved trees, is also increasing with the progress of their succession as a result of the disuse of fuel wood forests surrounding communities.

Figure 21: Change in the growing stock of planted forests (million m^3)



Source: Forestry Agency. State of Forest Resources

Figure 22: Change in the growing stock of natural forests (million m^3)



Source: Forestry Agency. State of Forest Resources (as of March 31, 2007)

INDICATOR 2.c Area, percent and growing stock of plantations of native and exotic species

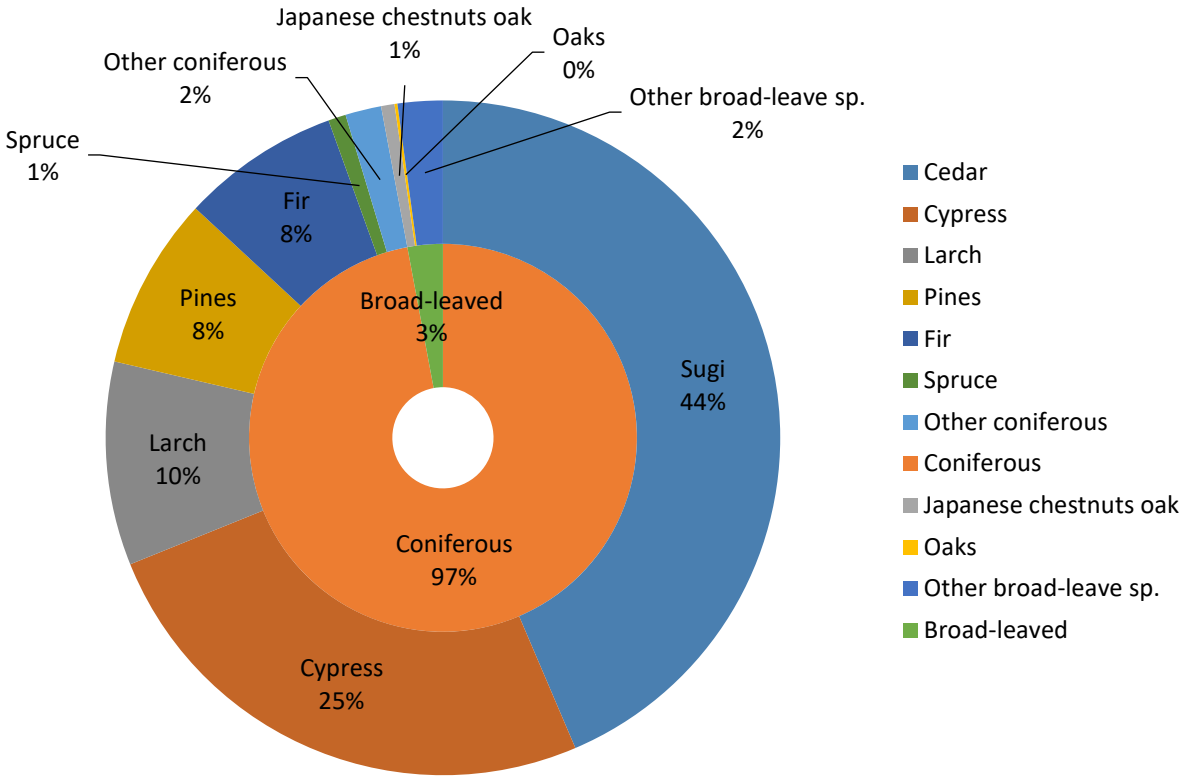
Rationale

This indicator provides information on the nature and extent of plantation forests. Changes in the area of plantation reflect society's present and future needs or the impact of competing land uses on forest cover. The use of both native and exotic plantation species may enhance the range and quantity of goods and services available.

Current state and trend

Planted forests cover approximately 10.29 million ha in Japan, accounting for 41% of its total forest area. Regarding the species, Japanese cedar holds the highest percentage, occupying 44%, and is followed by Japanese cypress and Larch (*Larix kaempferi*), occupying 25% and 10% respectively. The major species for planting in Japan are all native species.

Figure 23: Composition of species in area of Japan's planted forests (%)

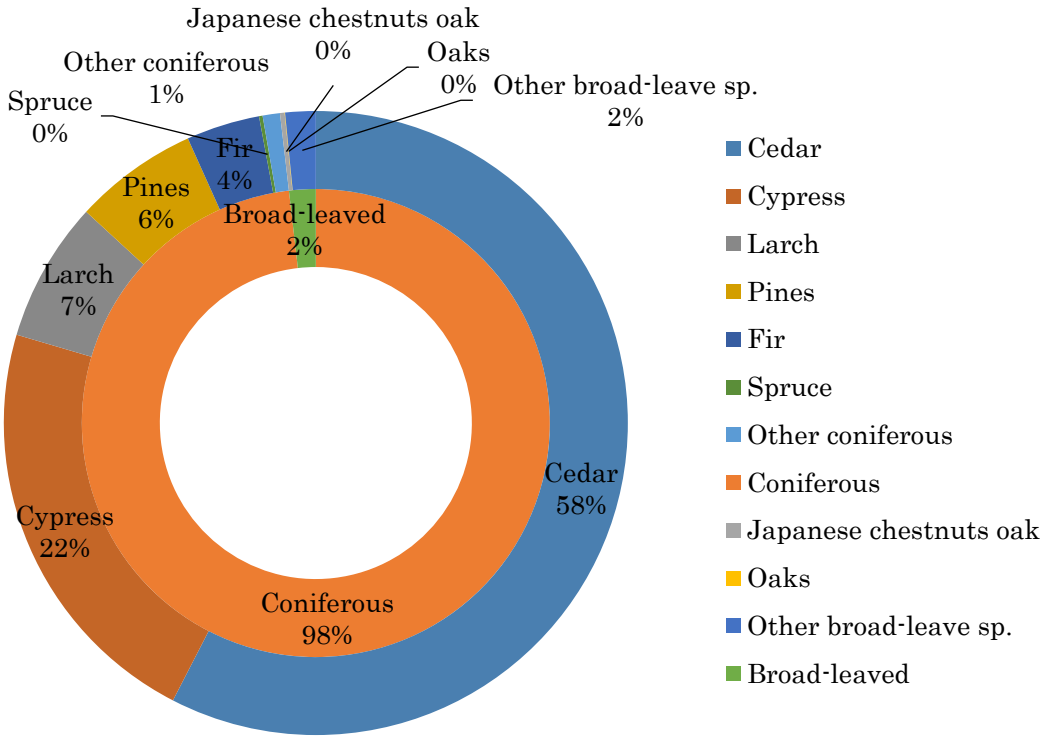


Source: Forestry Agency, State of Forest Resources (2012)

According to the third stage of the National Forest Inventory of Japan, among planted forests, the plots in which exotic species have become the dominant is accounted for 1.03% of the overall plots. Of which, bamboos, such as thick-stemmed bamboo (*Phyllostachys edulis*), giant timber bamboo (*Phyllostachys bambusoides*) and henon bamboo (*Phyllostachys nigra var. henonis*), coniferous trees, such as strobe pine (*Pinus strobus*), Dahurian larch (*Larix gmelinii*) and Norway spruce (*Picea abies*), and broad-leaved trees, such asblack lotus (*Robinia pseudoacacia*), kaki (*Diospyros kaki*) and empress tree (*Paulownia tomentosa*), were observed.

In 2012, the growing stock of planted forests was approximately 3.042 billion m^3, accounting for approximately 62% of the total growing stock of the forests in Japan. Japanese cedar, Japanese cypress and larch accounted for 58%, 22% and 7% of such growing stock, respectively.

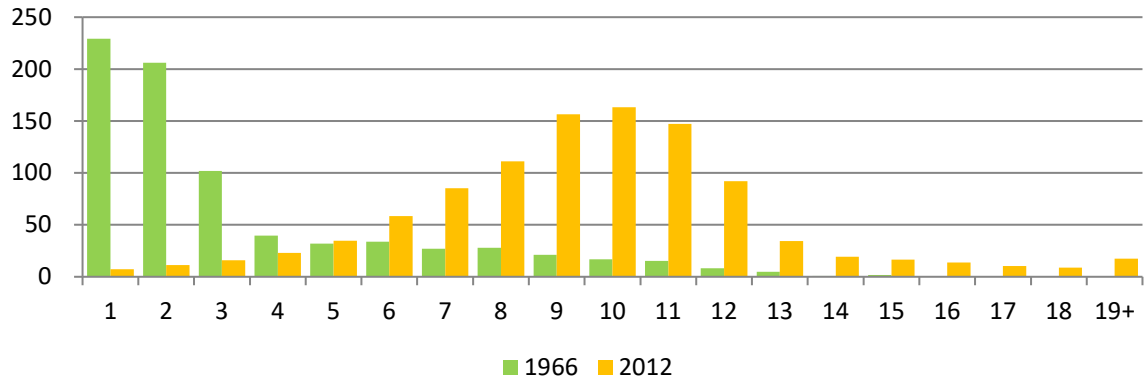
Figure 24: Composition of species in growing stock of planted forests (%)



Source: Forestry Agency, State of Forest Resources (2012)

The majority of the planted forests of Japan were established during the late 1950s through the early 1970s while wood demands for construction and pulp was increasing under the rapidly growing economy. Nowadays, about half such forests have reached the age higher than age class 10, a stage in which they can be used as resource.

Figure 25: Change in composition of age class of planted forests (10 thousand ha)



Source: Forestry Agency, State of Forest Resources

New movement is emerging in development of silviculture techniques. This movement is supported by increasing interests to coniferous and broad leaves trees that grow fast, in the context of reducing re-planting costs etc.

INDICATOR 2.d Annual harvest of wood products by volume and as a percentage of net growth or sustained yield

Rationale

This indicator compares actual harvest levels against what is deemed to be sustainable. The purpose is to assess whether forests are being harvested beyond their ability to renew themselves or are being under-utilised for wood products.

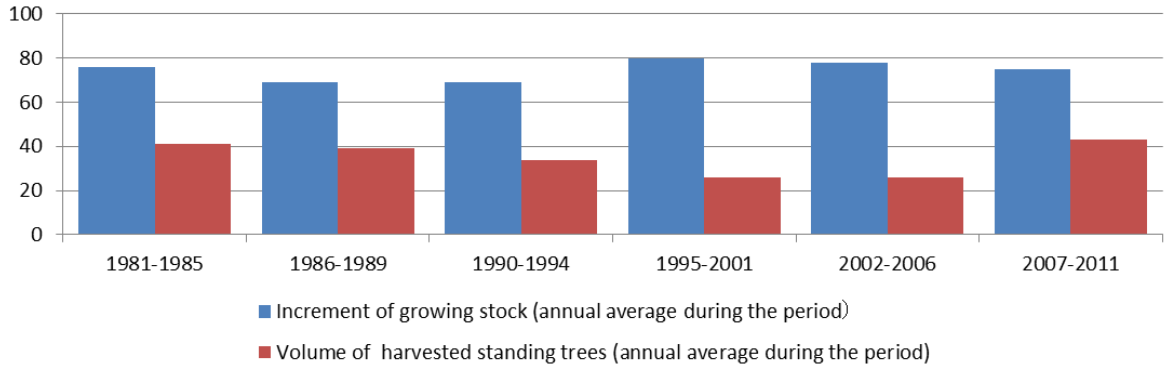
Current State and Trends

In the past 30 years, forest growing stock has increased by about 70 to 80 million m^3 on annual average. The change of growing stock is obtained by subtracting the harvest and loss through natural processes from the net growth of forests. An increasing trend means that the harvest is within the range of the net growth of forests as a whole. Therefore, the level of forest harvest is within a sustainable range.

The volume of harvested standing trees had continued to decline at an annual average of 30 to 40 million m^3, but increased by 43 million m^3 on annual average for five years from 2007 to 2011. This is considered to be partly because a goal of thinning 3.3 million ha for six years from FY2007 to FY2012 was set toward securing of the forest sequestration set forth in the Kyoto Protocol Target Achievement Plan and efforts were made for its steady implementation.

An additional boost may have been provided by the progress of technology development. For example, small-diameter coniferous log produced by thinning turned out usable as plywood material in the first half of the 2000s. As mentioned in Indicator 2.c, Japan’s planted forests as a resource has reached maturity. In order to establish a cyclic utilization system of forest resource of cutting, planting and tending, the promotion of regeneration cutting is also expected.

Figure 26: Changes in average annual increment of growing stock and harvested volume (million m³)



Note: Increase in growing stock for 2007-2011 includes estimated values.

Source: Forestry Agency. State of Forest Resources, Statistics on forest and forestry

INDICATOR 2.e Annual harvest of non-wood forest products

Rationale

This indicator reports on the sustainability of the harvest of non-wood forest products. The wellbeing of indigenous and other communities dependent on non-wood forest products may be closely allied to forests' ability to maintain productive capacity over time

Current State and Trends

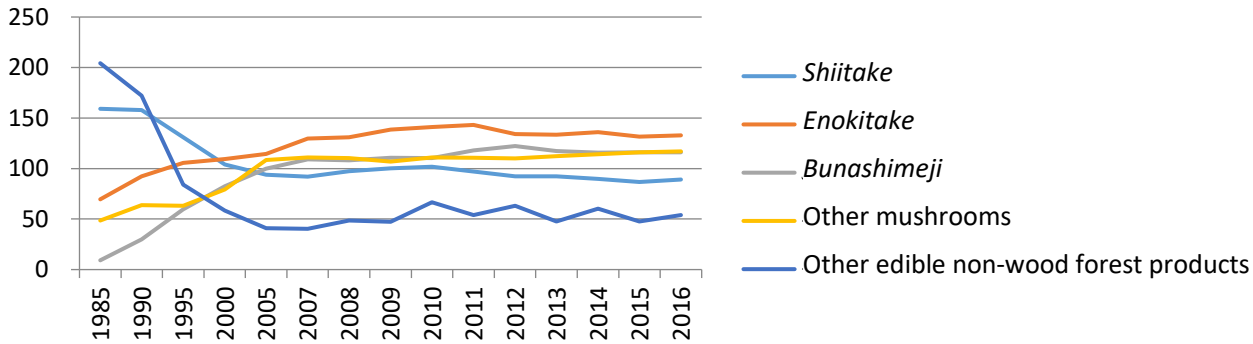
Edible mushrooms such as *shiitake*, *enokitake*, and *bunashimeji* mushrooms, tree fruits, and edible wild plants are included in non-wood forest products. The production and sales of these products are one of the industries using local resources of farming and rural mountain communities and have been fulfilling a major role in ensuring the stability of the regional economy and securing job opportunities.

Edible mushrooms, in particular, are major products which account for about 90% of edible non-wood forest products in volume. The production of *enokitake* mushroom is the largest, at 133,000 tons, followed by *bunashimeji*, at 116,000 tons in 2016. These data are on cultivated mushrooms. The yield of wild mushrooms that are mainly for domestic consumption is not known.

In Japan, more than 2,000 kinds of wild plants have been processed and eaten as preserved food. Representative kinds are young shoots of certain ferns, such as bracken fern and Asian royal fern, and young sprouts of trees, such as Japanese angelica trees.

Damage to crops caused by wild birds and animals living in forests, including deer, wild boars, and monkeys has become a very serious problem. The damage reached 17.6 billion yen in 2015. As a result of the promotion of countermeasures, the number of captured wild animals has been increasing year by year. In response, efforts to use captured animals as local resources, such as game meat, are spreading to many regions. The Ministry of Agriculture, Forestry and Fisheries, in cooperation with the Ministry of Health, Labour and Welfare, are working to ensure the safety of game meat as food while at the same time supporting efforts to develop meat processing facilities for captured birds and animals, develop game-meat products based on consumer needs, and establish distribution and marketing channels. Because the distribution of game meat requires the development of unified handling standards and display information, the ministry supports the formulation and operation of unified specifications of game meat by private groups. Its experimental operation started in FY2017.

Figure 27: Change in volume of production of on-wood forest products (thousand tons)



Source: Forest Agency. Basic Data of Edible Non-wood Forest Products

Criterion 3 Maintenance of forest ecosystem health and vitality

The maintenance of forest health and vitality is dependent upon the ability of the forest ecosystem's functions and processes to recover from or adapt to disturbances. While many disturbance and stress events are natural components of forest ecosystems, some may overwhelm ecosystem functions, fundamentally altering their patterns and processes and reducing ecological function.

Decline in forest ecosystem health and vitality may have significant economic and ecological consequences for society including a loss of forest benefits and the degradation of environmental quality.

Information gained on the impacts of biotic and abiotic processes and agents may inform management strategies to minimize and mitigate risk. The maintenance of forest ecosystem health and vitality is the foundation of sustainable forest management.

INDICATOR 3.a Areas and percent of forest affected by biotic processes and agents (e.g. disease, insects, invasive alien species) beyond reference conditions

Rationale

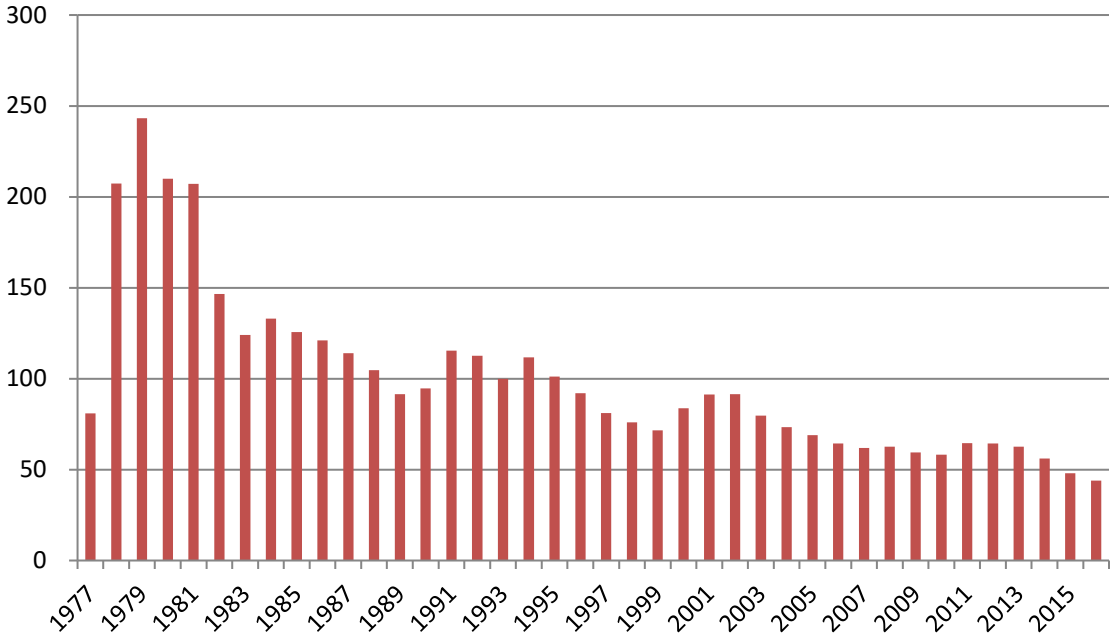
This indicator identifies the impact that biotic processes and agents have on forests. Where change due to these agents and processes occurs beyond a critical threshold, forest ecosystem health and vitality may be significantly altered and a forest's ability to recover could be reduced or lost. Monitoring and measuring the effects of these processes provides information helpful in the formulation of management strategies to mitigate risk.

Current state and trend

Pine wilt disease and Japanese oak wilt are major forest pests and diseases which damages forests in Japan.

Pine wilt disease occurs when pine wood nematode (*Bursaphelenchus xylophilus*) carried by the pine sawyer beetle (*Monochamus alternatus*) enter inside the body of pine trees. The volume of trees damaged by the disease recorded the highest of approximately 2.43 million m^3 in 1979 but has been declining over the long-term. In 2016, the volume was approximately 0.44million m^3, about one-fifth of the peak. However, it is still the most significant forest pests and disease in the country, and damages still occurr in all prefectures but Hokkaido in Japan.

Figure 28: Change in volume of trees damaged by pine wilt disease (10,000 m³)



Source: Forestry Agency

Figure 29: Plots that were suffered pine beetle syndromes (Third stage)

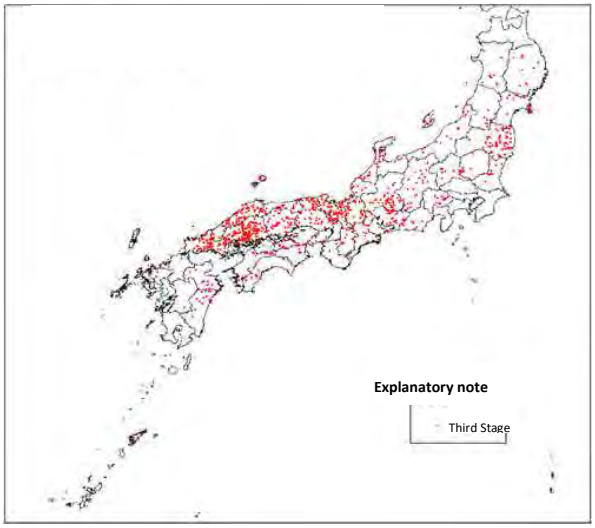
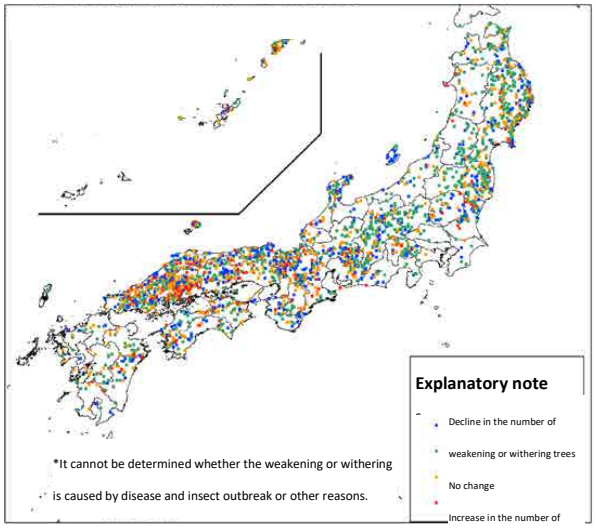


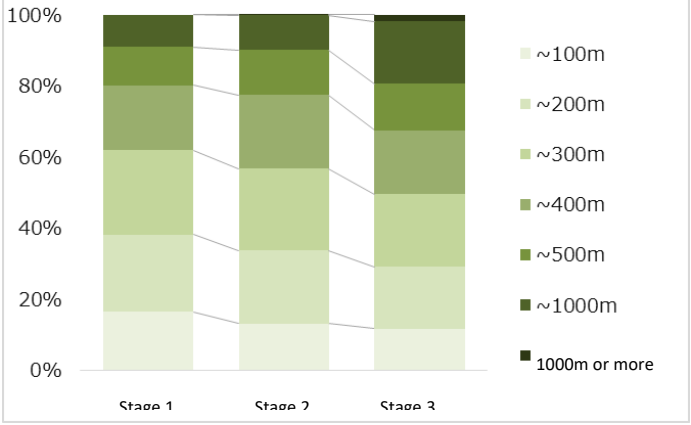
Figure 30: Plots that emerge weakening and withering of pine trees (comparison of second and third stage)



In the National Forest Inventory of Japan, the survey of the state of weakening or withering of standing trees is also taken. The survey is carried by visual observation, and identification test to determine whether the weakening or withering of pine trees is caused by pine beetle syndrome is not conducted. However, it is considered that the survey could contain important information which shows

the distribution of pine beetle syndrome. Especially, in recent years, attention is paid to the fact that occurrence of weakening and withering of pine trees is shifting to higher altitude areas.

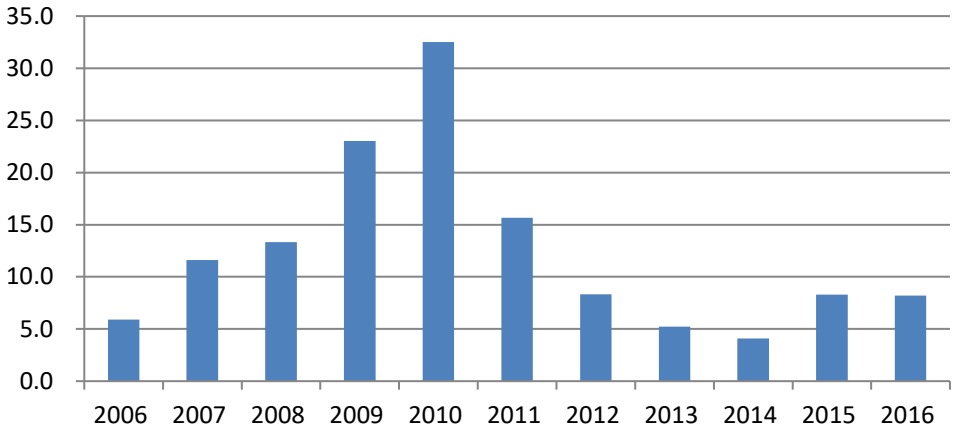
Figure 31: Ratio of plots that emerged weakening and withering of pine trees by altitude



Source: Forestry Agency, National Forest Inventory of Japan (Surveys of first to third stages)

Japanese oak wilt causes collective dieback of oak trees such as Mongolian oaks (*Quercus crispula Blume)*, with pathogenic fungus (*Raffaelea quercivora*) mediated by the Oak platypodid beetle (*Platypus quercivorus*). it is mainly found in the Sea of Japan side of the Honshu island. The volume of the tree damaged across the country was approximately 84,000 m^3 in 2016, about one-fourth of the maximum volume recorded in 2010. However, the area that suffered such damages extends to 32 prefectures.

Figure 32: Change in volume of trees damaged by Japanese oak wilt (10 thousand m^3)



Source: Forestry Agency

Similar to pine beetle syndromes, the distribution of weakening and withering of oak trees can be grasped from the results of the National Forest Inventory of Japan.

Figure 33: Areas that suffered oak withering disease (Third stage)

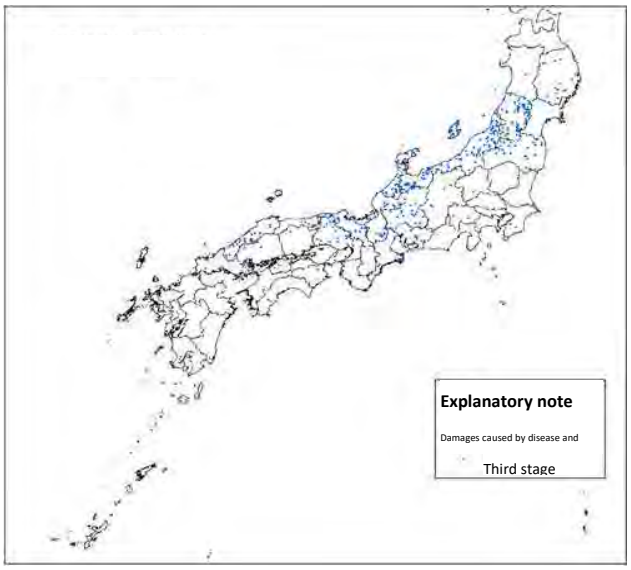
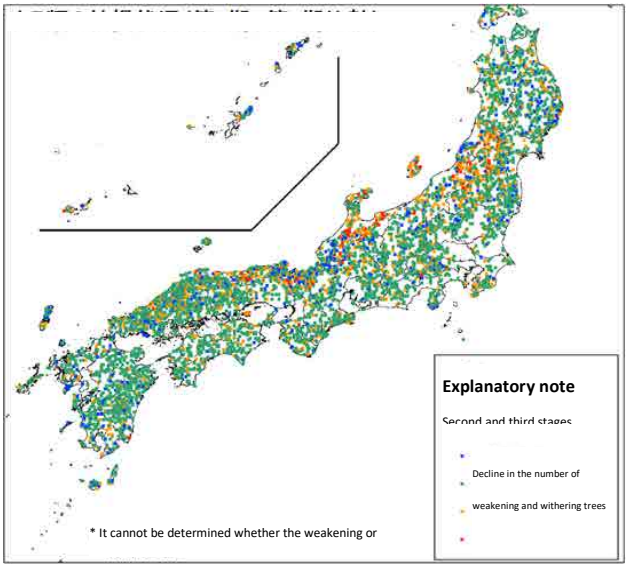


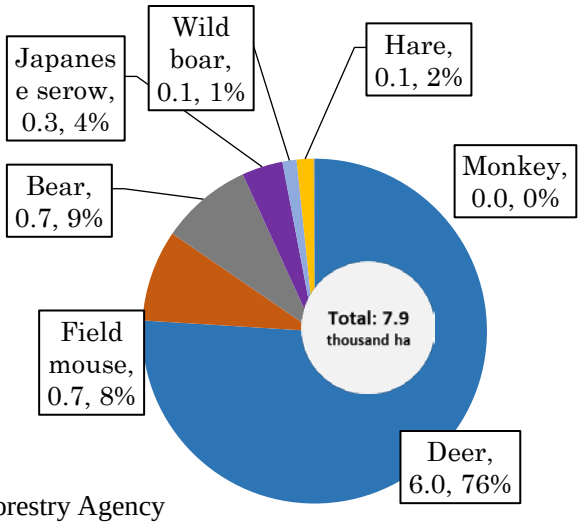
Figure 34: Comparison of the state of weakening and withering of oak trees



Source: Forestry Agency, National Forest Inventory of Japan (Surveys of first to third stages)

In addition, recently, as the habitat of wildlife, such as deer and bear, has been expanded, damage on forests caused by such wildlife has become more serious. The the damaged area in 2015 was approximately 8,000 ha across the country, of which approximately 80% caused by deer. Damages by deer leads to withering of trees or loss of the value of wood due to bark peel of matured trees in addition to inhibition of growth or withering of trees due to browsing of young shoots and bark of planted seedlings. In some forests where the density of deer is substantially high, planted seedlings and understory vegetation less than approximately two meters height can be reached by deer and are lost almost completely due to feeding pressure. In such places, there are concerns over the negative impact on the multiple functions of forests caused by the soil run-off due to loss of ground vegetation damaged by deer stomping.

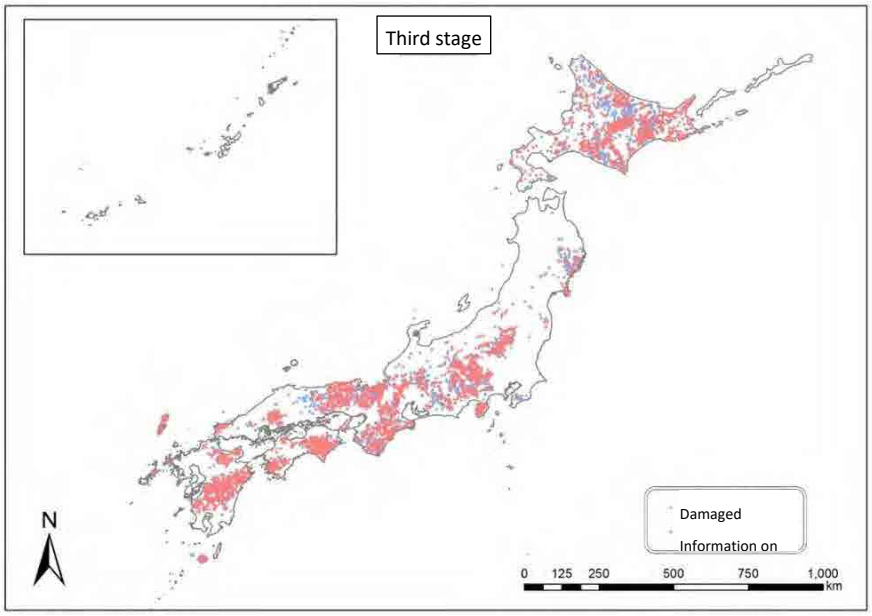
Figure 35: Area and ratio of damages on forests caused by major wildlife (2015)



Source: Forestry Agency

In the National Forest Inventory of Japan, damages caused by wildlife (peeling and feeding damage) as well as information on their habitation (droppings, footprints and furs, etc.) are also surveyed. With respect to deer, information including the distribution of damages is shown as follows.

Figure 36: Distribution of plots that contain information on damages caused by deer or their habitation



Source: National Forest Inventory of Japan (Third stage)

Some exotic species are invasive and threatening the ecosystem by eating the native species in Japan or depriving their habitat or food, thereby posing a serious problem in conserving the biodiversity of Japan in which the biota and ecosystems unique to each area are formed. In Japan, invasive alien species have been designated under the Invasive Alien Species Act and their importation, rearing, etc. are controlled. The number of designated invasive alien species as of May 2018 is 146 (including 2 families, 15 genera, 122 species and 7 crossbreed).

INDICATOR 3.b Area and percent of forest affected by abiotic agents (e.g. fire, storm, land clearance) beyond reference conditions

Rationale

This indicator identifies the impact that abiotic agents, both natural and human-induced, have on forests. Where change occurs due to these agents and processes beyond a critical threshold, forest ecosystem health and vitality may be significantly altered and a forest's ability to recover from disturbance could be reduced or lost. Monitoring and measuring the extent of forest affected by physical agents provides information to guide the formulation of management strategies to mitigate risk.

Current state and trend

Natural disasters in mountainous areas caused by typhoons, snow melting and volcanic activity etc., such as hillside failures and debris flow, tend to occur due to Japan's geographic nature, such as its steep terrain, geological vulnerability, steep river water flow and Japan's global location in volcanic zone.

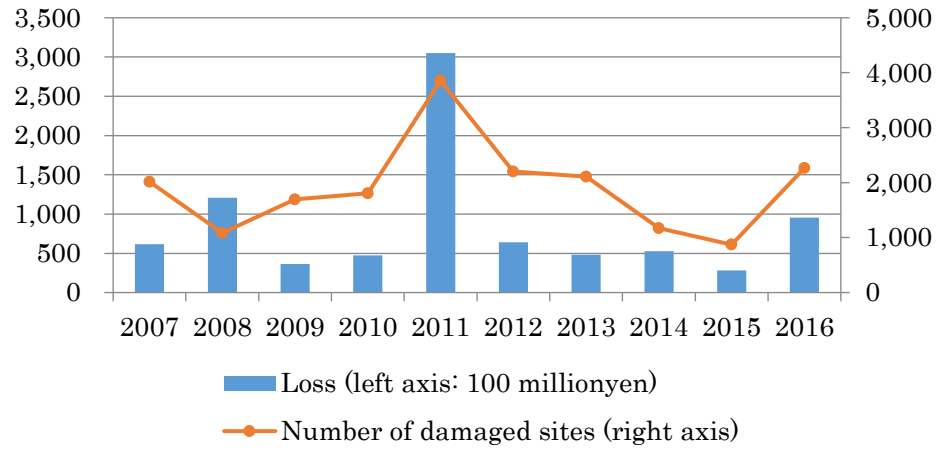
Annual average precipitation is approximately 1,718 mm; about 1.6 times as much as the global average (approx. 1,065 mm)[21]. Some precipitation is brought as torrential rain during the rainy season from early June to mid-July and the typhoon season from July to October and snowfall in the winter season.

In recent years, in addition to the increase trend in intense rainfall, it has been pointed out that heavy rainfall events are likely to be more frequent, in the context of climate change. Thus, there are concerns to the increasing risks of natural disasters in mountainous areas, especially associated with rainfall, in the future.

In the past 10 years from 2007 to 2016, natural disasters in mountainous areas occurred in approximately 1,900 sites per year and the damages are estimated approximately 85.5 billion yen per year. Large damage in 2011 indicates the Great East Japan Earthquake that occurred in March.

[21] Average of Japan is based on "Current State of Water Resources in Japan" (MLIT 2018), and the global average is based on FAO/AQUASTAT.

Figure 37: State of occurrence of forest disasters in recent years



Source: Forestry Agency

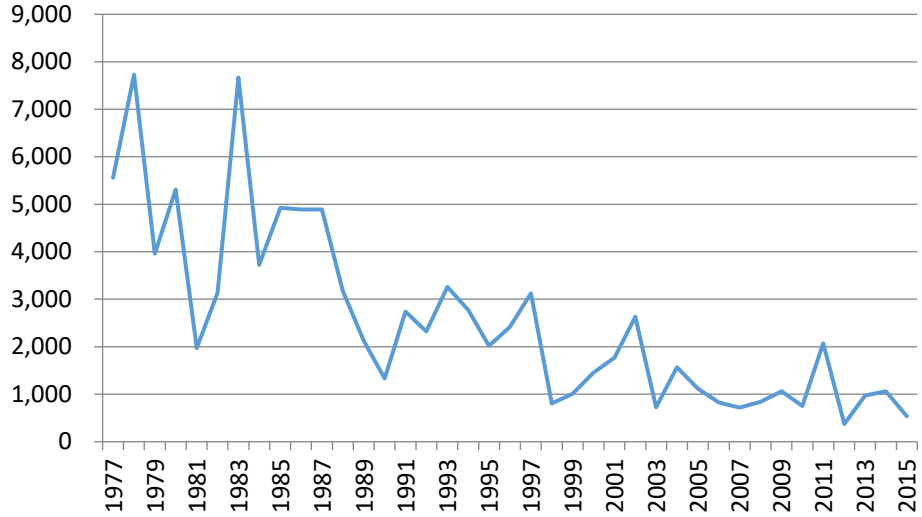
In the Great East Japan Earthquake that occurred in March 2011, a large area of coastal forests on the Pacific Ocean, approximately 140km length in total between Aomori and Chiba prefecture, was destroyed by the resulting tsunami. The coastal forests helped to reduce the damage from the tsunami to some extent by mitigating the tsunami energy and preventing the inflow of drifting materials while trees in lowland were uprooted or washed away. Currently, restoration of damaged coastal forests are carried out and are planning to be completed by the end of 2020.

Picture 1: Damages on coastal forests (Sendai city, Miyagi prefecture)

Picture 2: Restoration of coastal forests (Sendai city, Miyagi prefecture)

Forest fire may record more than 5,000 ha annually until the 1980s, but has been tracking a downward trend and declined to a level of 1,000 ha recently. The causes of forest fires in Japan are mostly human-induced, such as the careless handling of open fire and slash burning. Activities for preventing forest fires, such as awareness raising activities including forest patrol and nationwide campaign for forest fire prevention, are operated as well as institutional development of early warning and control system.

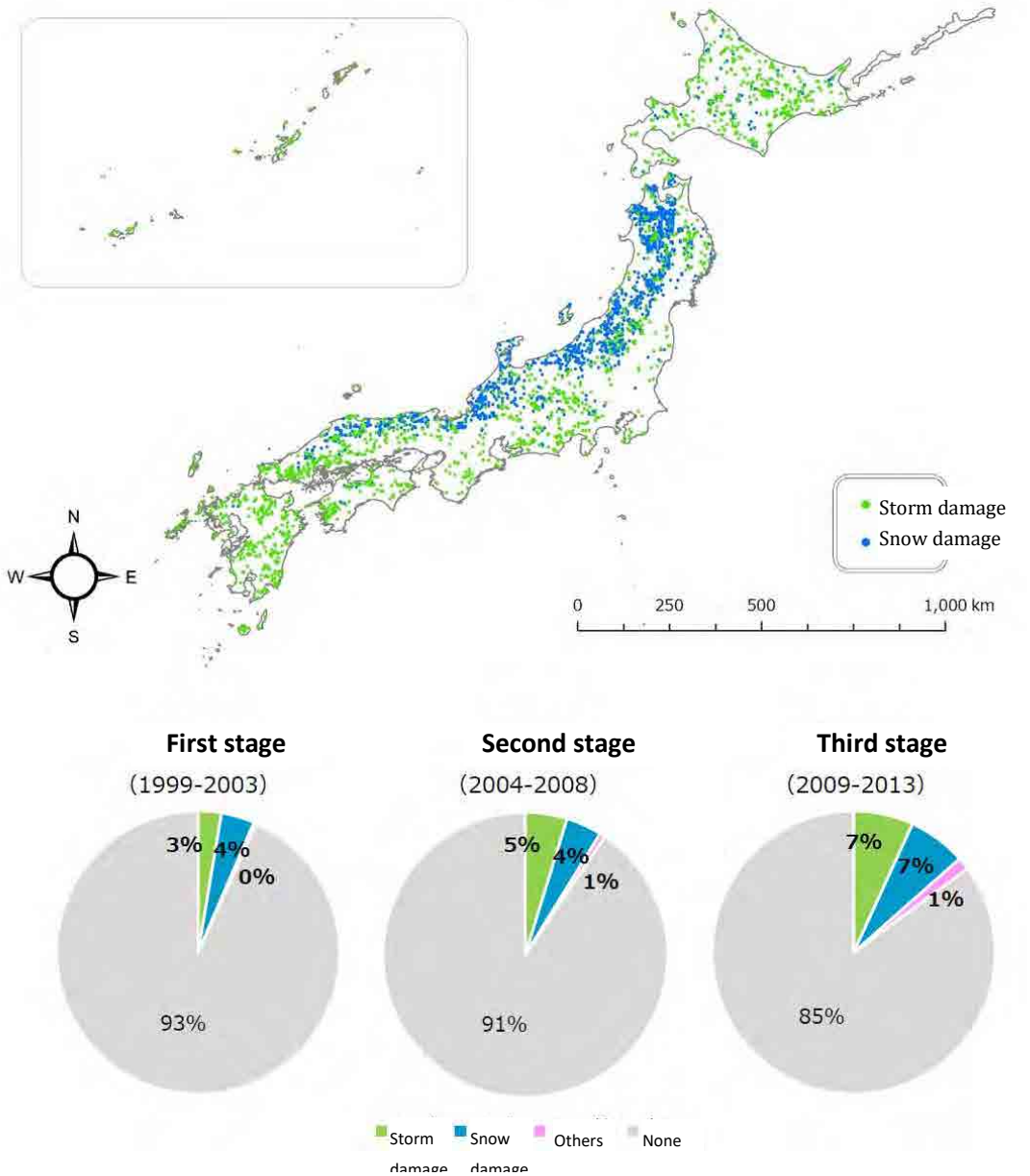
Figure 38: Area of forest burned by forest fires (ha)



Source: Forestry Agency, data based on statistical information available from the Fire and Disaster Management Agency

According to the results of the National Forest Inventory of Japan, 15% of the forests in Japan has suffered damages caused by extreme weather events, such as storm and snow, during the five year period 2009 - 2013.

Figure 39: Occurrence of damages caused by extreme weather events (Third stage)



Source: Forestry Agency, National Forest Inventory of Japan (Surveys of first to third stages)

Criterion 4 – Conservation and maintenance of soil and water conservation

Soil and water underpin forest ecosystem productivity and functions. Forest ecosystems play an important role in the regulation of surface and groundwater flow and, together with associated aquatic ecosystems and clean water, they are essential to the quality of human life.

The interactions of soil, water, climate, topography, and biological activities influence the character and health of streams and rivers flowing through and from forests. Monitoring change in the chemical, physical, and biological characteristics of soil, water and aquatic systems provides valuable information to support sustainable forest management.

Forest management activities can significantly alter forest soils, water quality and quantity, and associated aquatic habitats. Appropriate forest management can protect and conserve the soil and water values of a forest and of downstream land uses. Inappropriate management may result in soil compaction, soil erosion, loss of riparian buffering capacity, increased sediment loads in streams, degradation and destruction of riparian and aquatic habitats and altered flow regimes. The quantity of water flowing from a catchment can vary due to forest management activities in the catchment, including both forest harvesting and the establishment of new forests, depending on previous land use in that catchment. Change in water flow can lead to an increased risk of flooding or to a reduction in the quantity and flow of water in streams and affect other land use activities downstream. Both outcomes can have detrimental implications for human safety, property, and economies.

Soil and water health, quality and resources may be protected through the allocation of land for that purpose or through appropriate management regimes and best management practices.

4.1 PROTECTIVE FUNCTION

Healthy and productive forests depend on the maintenance of the soil and water resource. Forests also regulate these resources by moderating the flow of water, controlling erosion, maintaining water quality, and preventing catastrophic events such as flooding, avalanches and mudslides.

INDICATOR 4.1.a Area and percent of forest whose designation or land management focus is the protection of soil or water resources

Rationale

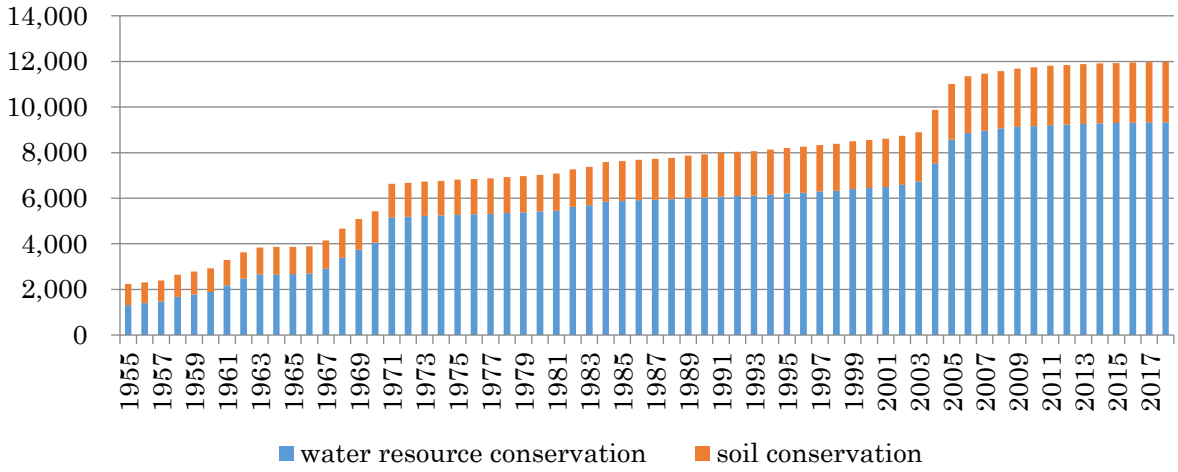
The area and percent of forest designated or managed primarily for the protection and regulation of soil and water reflects the importance of these resources to society, including the tradeoffs made between other uses.

Current state and trend

Currently, approximately 12 million ha of forests, which account for 48% of the total area of Japan's forests, are designated as the protection forest for the conservation of soil and water resources. The area of these protection forests has constantly increased since their establishment in 1897.

Protection forests are forests designated by the Minister of Agriculture, Forestry and Fisheries or the prefectural governor in order to achieve specific public objectives, such as headwater conservation, disaster prevention including erosion control and formation of living environments. In protection forests, logging operations and changes to the form and nature of land, etc. are regulated to secure the function of forests in line with the respective purpose. There are 17 types of protection forests based on the designated objective including those other than water resource conservation and soil conservation as mentioned herein.

Figure 40: Change in areas of protection forests for soil and water resource conservation (1,000ha)



Source: Forestry Agency (Soil conservation shows the total area of protection forests for soil conservation while water resource conservation shows the total area of protection forests for headwater conservation and drought prevention)

Table 5: Area of protection forests related to conservation of water resources and soil (as of March 31, 2018)

	Area of protection forests (ha)
Headwater conservation	9,204,127
Drought prevention	126,050
Subtotal related to water resources	9,330,177
Soil run-off prevention	2,595,753
Landslide failure prevention	59,769
Subtotal related to soil conservation	2,655,522
Total (ha)	11,985,699

Table 6: Categories of protection forests

Category No.1	Headwater conservation
2	Soil run-off prevention
3	Hillside failure prevention
4	Sand shift prevention
5	Windbreak
6	Flood damage mitigation
7	High tide and salty wind damage mitigation
8	Drought prevention
9	Snow-break
10	Fog inflow prevention
11	Avalanche prevention
12	Rockfall prevention
13	Fire spread prevention
14	Fish breeding
15	Navigation landmark
16	Public health
17	Landscape conservation

4.2 SOIL

Forest soils support forest productivity and other ecological and hydrological functions through their ability to hold and supply water and nutrients, store organic matter, and provide habitats for plant roots and for a wide range of soil organisms. These soil-related functions are mainly found on or around the forest floor. A decrease or loss of soil resources or inappropriate disturbance of the forest floor may bring about a decline and deterioration of the provision and adjustment of forest health and other ecosystem services.

INDICATOR 4.2.a Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources

Rationale

This indicator provides information about the extent to which soil resource protection, legislation, and best management practices have been embodied and integrated into forest management activities. Inappropriate activity may result in the loss of soil nutrients, forest productivity, and other ecosystem services that soils provide.

Current State and Trends

As stated in Indicator 4.1.a, protection forests are designated for the conservation of soil and water resources and other purposes. Currently about 3 million ha forests are designated as protection forests mainly for the conservation of soil resources. In protection forests, logging operations and changes to the form and nature of land, etc. are regulated in line with the respective purpose. A technical guideline is also provided for the effective and efficient implementation of the forest conservation program, which is carried out for the restoration of devastated forests and forest land.

As a basic guideline on the handling of forests toward the fulfillment of the multiple forest functions, the nation-wide forest plan establishes guidelines on forest management practices and protection for each of (1) water resource conservation, (2) mountainous disaster prevention/soil conservation, (3) comfortable environment creation, (4) health and recreation, (5) culture, (6) biological diversity conservation, and (7) timber production functions.

For forests requiring the prevention of soil run-off, hillside failure, or other mountainous hazards—including forests at risk of a landslide, etc. that could involve human lives and damage houses and other facilities—, the plan promotes improvement and conservation to maintain and enhance mountainous disaster prevention/soil conservation functions. Specifically, in order to develop a disaster-resilient nation, the plan sets forth the promotion of management practices to reduce and avoid forest-floor denudation, and management practices using natural forces with consideration of the topography, nature of the soil and other conditions. For areas with a high risk of mountainous disasters close to rural communities, the plan promotes the designation and appropriate management of protection forests to secure fulfillment of the functions to prevent sediment outflow, and when necessary to prevent bank erosion or fix spurs, promotes the setting up of valley closing, soil retaining, or other facilities.

Forest areas for which maintenance and enhancement of mountainous disaster prevention/soil conservation functions are promoted are identified in the Local Forest Improvement Plan, which are formulated by municipal mayors for private forests, and in the Regional Plan for National Forest.

Currently 4.81 million ha are designated across the country. These forests are managed in line with the management practice policy set force in the respective plans above, technical guidelines for forest conservation, facility management guidelines for appropriate management of forest conservation facilities, and other relevant rules and guidelines.

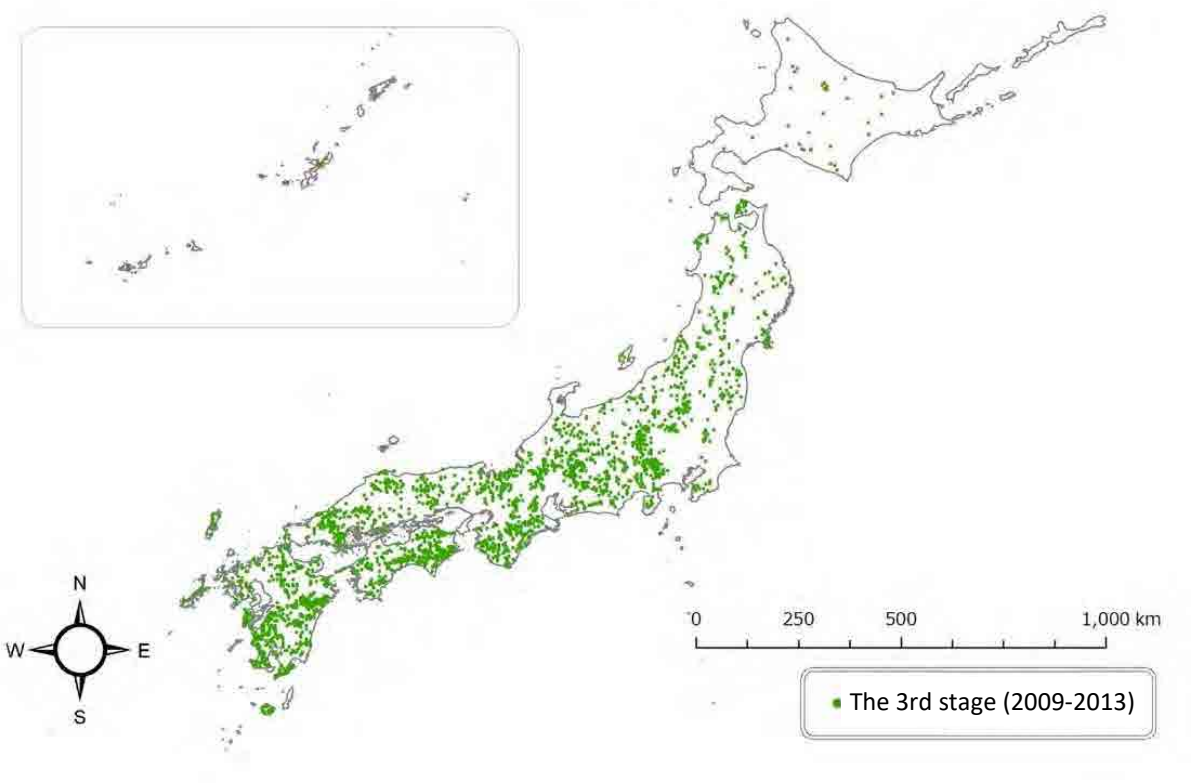
INDICATOR 4.2.b Area and percent of forest land with significant soil degradation

Rationale

This indicator provides information on the extent of significant soil degradation in forests likely to affect productivity, hydrology, ecosystem processes, or social and cultural benefits. This indicator is primarily concerned with degradation caused directly or indirectly by human induced activity.

Current State and Trends

Figure 41: Distribution of soil erosion



Note: The dots indicate the plots where any of a soil column, rill, or gulley was found.

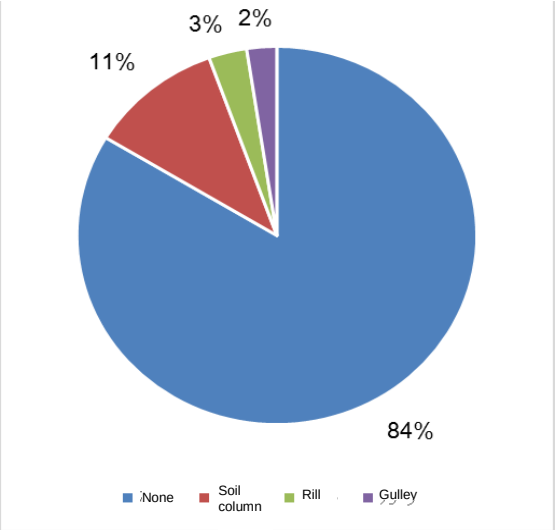
The situation of forest soil erosion was assessed based on the results of the third stage of the National Forest Inventory of Japan. Specifically, incidences of a soil column,[22] rill, or gulley[23] are considered

[22] A type of soil erosion trace where the soil layers under stones, roots on the ground, or branches/leaves were protected from rain drop erosion and have remained in the shape of a column of 2cm or higher.

[23] A type of soil erosion trace. A groove caused by surface running water and whose depth is less than 30cm (excluding grooves that gather water due to the landform such as the head slope of a swamp) is called a "rill," and a groove that

as soil erosion, and are checked in the vegetation survey area set up in plots. Soil erosion was found in 16% of the plots: in the breakdown, soil columns account for 11%, rills for 3% and gullies for 2%. As regards geographical distribution, soil erosion seems to be found more often in plots in central and western regions. Whether the soil erosion was caused by human induced activities or natural processes cannot be determined.

Figure 42: Percentage of the plots where soil erosion was found



Picture 3: Soil column

Picture 4: Rill

Picture 5: Gulley

Source: Forestry Agency. National Forest Inventory of Japan (Third stages) and its website

Looking at the percentage of the plots with soil erosion by forest type, the ratio was 18% for planted forests, and 15% for natural forests. No significant differences were found.

has further developed reaching 30cm or deeper (excluding a groove that gathers water due to the landform, such as head slope of a swamp, and a groove constantly having running water) is called a "gulley."