

Forests in 2050

Revised

Research and Development Roadmap for
Nurturing and Harnessing Forests



National Research and Development Agency
Forest Research and Management Organization
Forestry and Forest Products Research Institute

Create “Future Forests”

The mission of the Forestry and Forest Products Research Institute (FFPRI) is to contribute to the establishment of a recycling-oriented society, which will harness the rich and diverse bounty of forests, through research related to forest science, forestry, and forest products industries, thereby contributing to the sustainable development of humanity.

Forests have various functions, including preservation of water supplies and quality, soil protection, production of renewable biological resources such as wood, carbon fixation, and conservation of biodiversity. Through these functions, they can make major contributions to the establishment and maintenance of a safe, secure environment for people while providing rich natural recreational and commercial benefits. Thus, they can greatly help efforts to address major problems confronting modern society caused by human activities, including shortages of resources, energy insecurity, and climate change.

Through various research and development programs FFPRI strives to address forests' increasingly important roles in resolving these problems. In 2008, with the aim of publicizing and helping people to understand our mission and its significance, we formulated a roadmap called “Forests in 2050”, which outlined the future directions and goals of our research and development efforts.

In March 2011, a major earthquake struck East Japan. This calamity

devastated local forests, as well as associated industries and people engaged in them, with no warning, and restoration efforts are still ongoing. Furthermore, many extreme weather events have been raging across the globe in recent years, with localized downpours and landslides becoming more frequent in Japan, while escalating deforestation and forest degradation pose major concerns in developing countries. In Japan, the maturation of artificial forest plantations has promoted utilization of wood resources and triggered the transformation of forestry and wood industries into growth industries. Against these backdrops, solutions to various forestry-related challenges are being sought.

With the belief that the circumstances facing modern society present new opportunities, as well as severe challenges, FFPRI decided to revise the “Forests in 2050” roadmap.

The institute's divisions all have specific goals, but we all share the same ultimate objective, “to contribute to the establishment of a sustainable and recycling-oriented society that will harness the bounty of forests.”

To do so, and assist the creation of “future forests”, FFPRI will continue striving to maximize its research and development achievements, and serve as a bridge between diverse segments of society and industry to utilize our findings.

Research and Development toward “Future Forests”

The revised roadmap delineates the research directions into the following four focuses and clarifies research and development paths toward the goal of “future forests.”

Living with forests

Enhance forest functions closely related to our lives such as preservation of water supplies and prevention of natural disaster.

Protecting forests

Preserve forests as a present and future solution against concerns such as biodiversity and climate change.

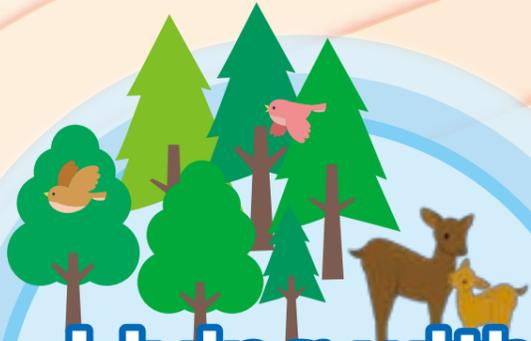
Nurturing forests

Foster new forests and forestry businesses using new technologies for a sustainable and active forestry.

Utilizing forests

Make effective use of forest resources to benefit both the society and economy by exploring potentiality of wood material.

Create “Future Forests”



Living with forests

- Conserve soil and water
- Prevent mountain disasters
- Enjoy nature and enrich the mind



Protecting forests

- Protect bountiful forests
- Maintain forest health
- Mitigate climate change



Nurturing forests

- Nurture forests using new technologies
- Foster active forestry

A sustainable and recycling-oriented society harnessing the bounty of forests



Utilizing forests

- Harness forest resources
- Use an abundance of wood

Conserve soil and water



Due to ongoing climatic change, concerns regarding the distribution of global precipitation likely becoming disturbed both geographically and seasonally are increasing. In the light of this possibility, securing access to safe and reliable sources of water has become a global concern. In Japan, although the overall rainfall has been increasing, changes are anticipated in the patterns of regional precipitation (rain or snow), aggravating the risk of floods and droughts.

Toward the realization of a recycling-oriented society, it is essential to make efficient use of forest resources. At the same time, it is equally important to appropriately manage watershed and forests in the mountains to secure adequate and sustainable water resources from forests.

In this context, FFPRI monitors the hydrologic cycle in forests under varied environmental conditions with respect to climate, geology, topography, and soil along with making research and development efforts to help assess and predict the impact of climate change and forestry activities on the hydrologic cycle and soil environments. By doing so, the institute aims to contribute to the achievement of forest management that maximizes forest functions to cultivate water sources.



Technologies and measures for creating "future forests"

- Monitoring of the water movement in forests
- Evaluation of the impact of climate change and forest practices
- Forecast on water balance as affected by climate change

5

Conserve soil and water

Research and development roadmap

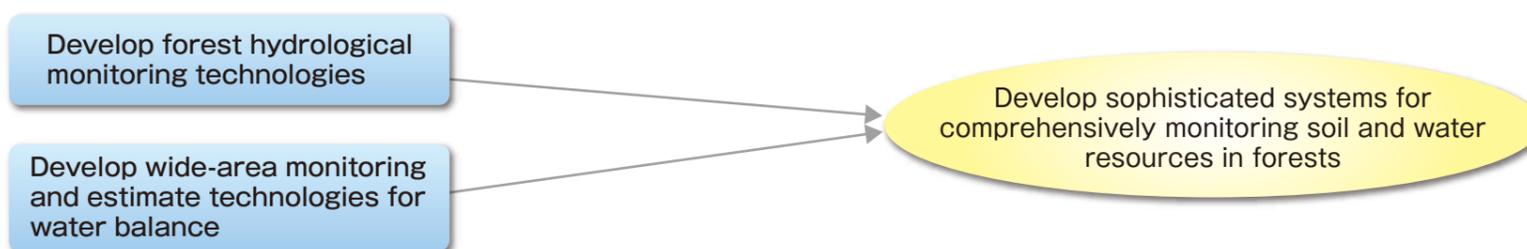
2020

2030

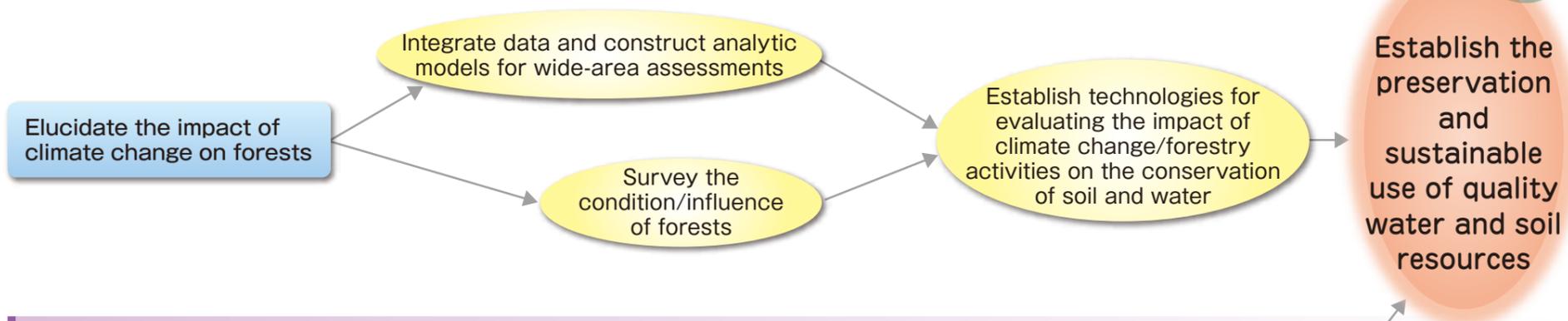
2040

2050

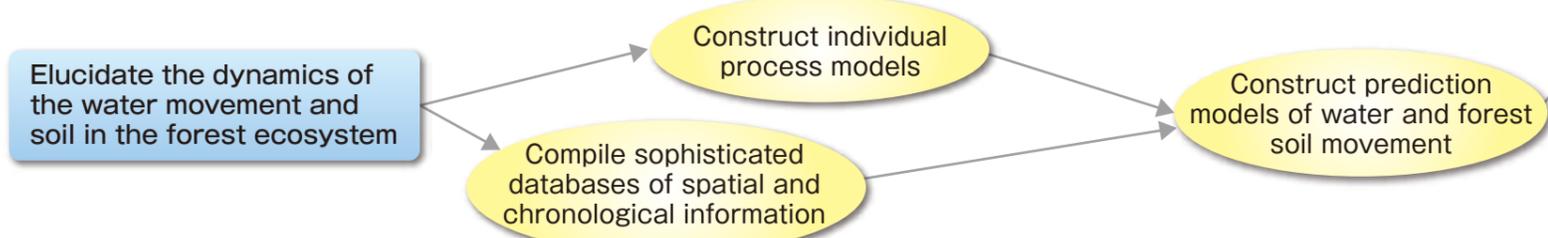
Monitoring of the water movement in forests



Evaluation of the impact of climate change and forest practices



Forecast on water balance as affected by climate change



6

Prevent mountain disasters



In recent years, natural disasters caused by extreme weather event, volcanic activities, earthquakes, and tsunamis have been ravaging the world. In Japan, record-breaking downpours have brought about scores of floods and landslides. The Great East Japan Earthquake and tsunami attacked coastal area of northeast region, and the ensuing nuclear meltdown at the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Plant crippled local communities and the forestry industry. Further restorations of forests and the industry are required in the affected areas.

To protect people's livelihoods from such natural disasters and establish a safe and secure society, it is essential to properly manage our forests for national resilience. Because forests cover 67% of the land in Japan, their functions of preventing landslides and soil erosion should be maximized for disaster prevention.

To this end, it is necessary to accurately assess and predict the risk of natural disasters and at the same time, establish a disaster prevention system specific to forests and mountains. FFPRI believes that further technological advances in land/forest management, observation/monitoring, and disaster mitigation/prevention are the key to realizing a safe and secure society.



Technologies and measures for creating "future forests"

- Forest management for maximizing disaster prevention functions
- Technologies for remote probes and terrestrial observations
- Technologies for disaster prediction and countermeasures

7

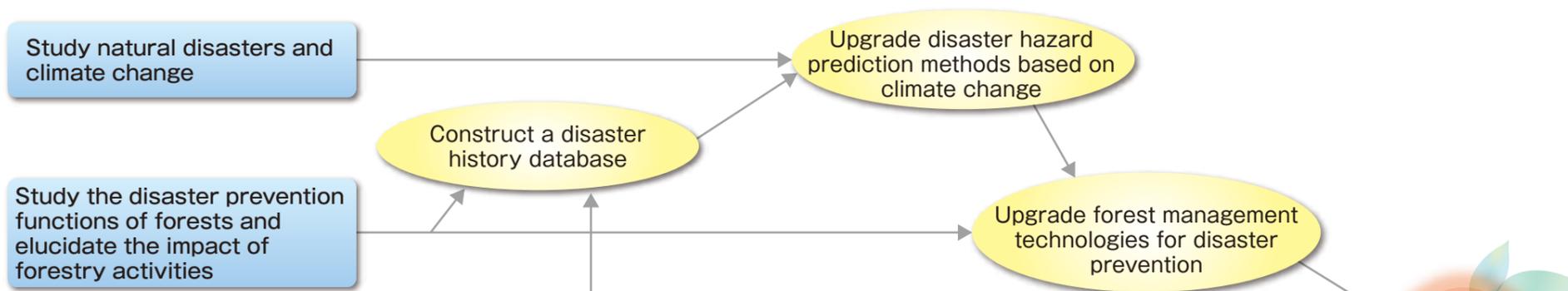
Preventing natural disasters

Research and Development roadmap

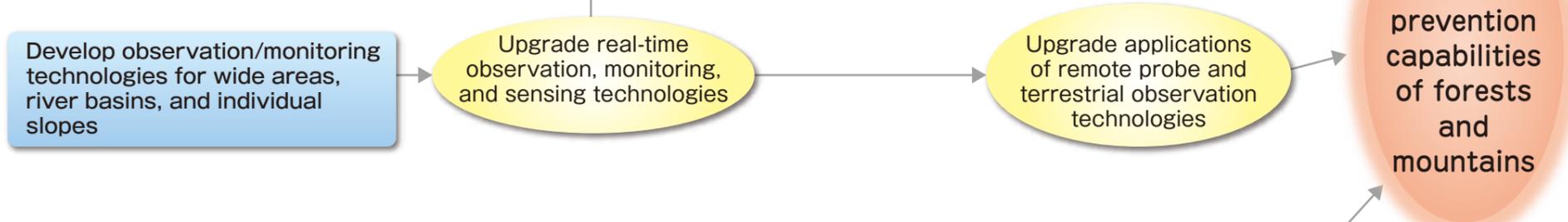


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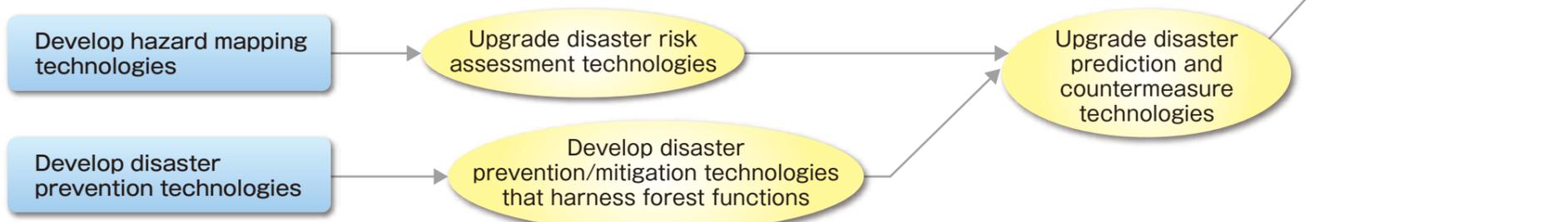
Forest management for maximizing disaster prevention functions



Technologies for remote probes and terrestrial observations



Technologies for disaster prediction and countermeasures



Enjoy nature and enrich the mind



“Mokuiku” is a Japanese word that does not have a precise English equivalent but encompasses education about forests, trees and wood: an educational activity aimed at enriching the mind, through which people of all ages learn to live with forests and trees.

It is crucial because forests provide important places for people to immerse themselves in natural, soothing and restorative environments. In addition to enjoying forests and trees, it is also important for people to learn more about the roles of forests to foster a recycling-oriented society. Thus, mokuiku can enrich people’s lives, minds and spirits.

Accordingly, a major part of FFPRI’s mission is to engage in and promote education and research on forests’ uses and benefits, to deepen public understanding of the relationships between human society and forest environments. From nearby woods in suburban areas to lush vegetation in remote mountains, forests are perfect venues for diverse outdoor activities. Research is essential to ensure that such activities are conducted in harmony with the environment. The Institute also promotes the utilization and management of familiar forests as hubs of local culture.

Japanese people have long harnessed forests and the goods they provide with reverence and awe. Forest resources have been used to

create numerous traditional artifacts, ranging from lacquerware and Japanese paper, to magnificent historic buildings such as the Ise Grand Shrine and Horyuji Temple. Flowering cherry trees, which have been grown since antiquity, are deeply ingrained in Japanese culture. FFPRI intends to develop future technologies that make ingenious use of such traditional applications and blessings of forests.



Technologies and measures for creating “future forests”

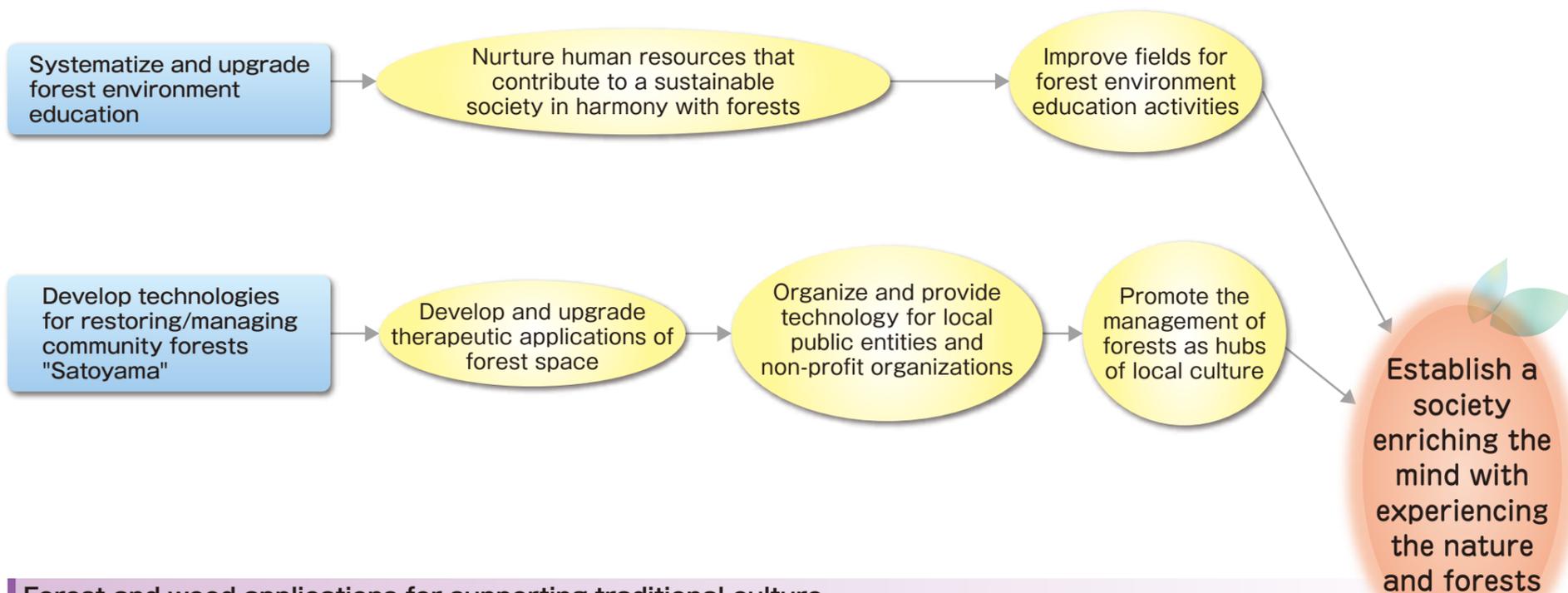
- Forest applications for enjoying nature
- Forest and wood applications for supporting traditional culture

Enjoy nature and enrich the mind

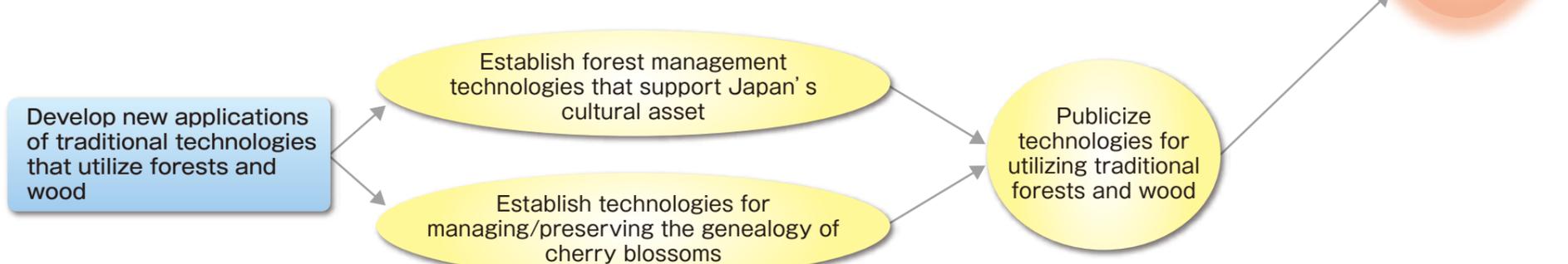
Research and Development roadmap



Forest applications for enjoying nature



Forest and wood applications for supporting traditional culture



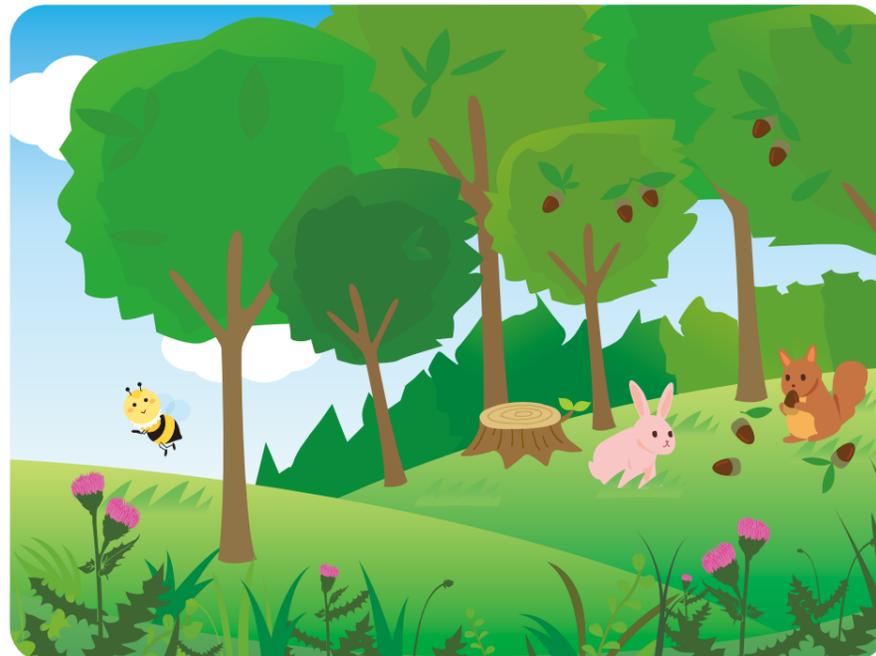
Protect bountiful forests



Forests harbor large parts of global biodiversity and provide us various ecological goods and services, such as air, water, food, and wood (ecosystem services). However, indiscriminate development or a lack of maintenance of forests, can alter the living environment for forest flora and fauna, which in turn may degrade the quality and quantity of ecosystem services provided by forests.

To address such problems, coordinated efforts by the international community are indispensable. To achieve the goals set forth by the Convention on Biological Diversity, the signatories are required to act decisively with an eye toward “realizing a world coexisting with nature” by the year 2050.

To this end, FFPRI intends to develop measures for assessing and preserving forest ecosystem services derived from biodiversity. The institute aims to reveal the ecological function of forest organisms and ecosystems from varied perspectives and comprehensively manage forest ecosystems along with conserving biodiversity (ecosystem management), thereby creating a framework of coexistence between humans and forests to better harness forest’s blessings in future.



Technologies and measures for creating “future forests”

- Technologies for conserving/restoring biodiversity
- Assessment and sustainable use of ecosystem services/genetic resources

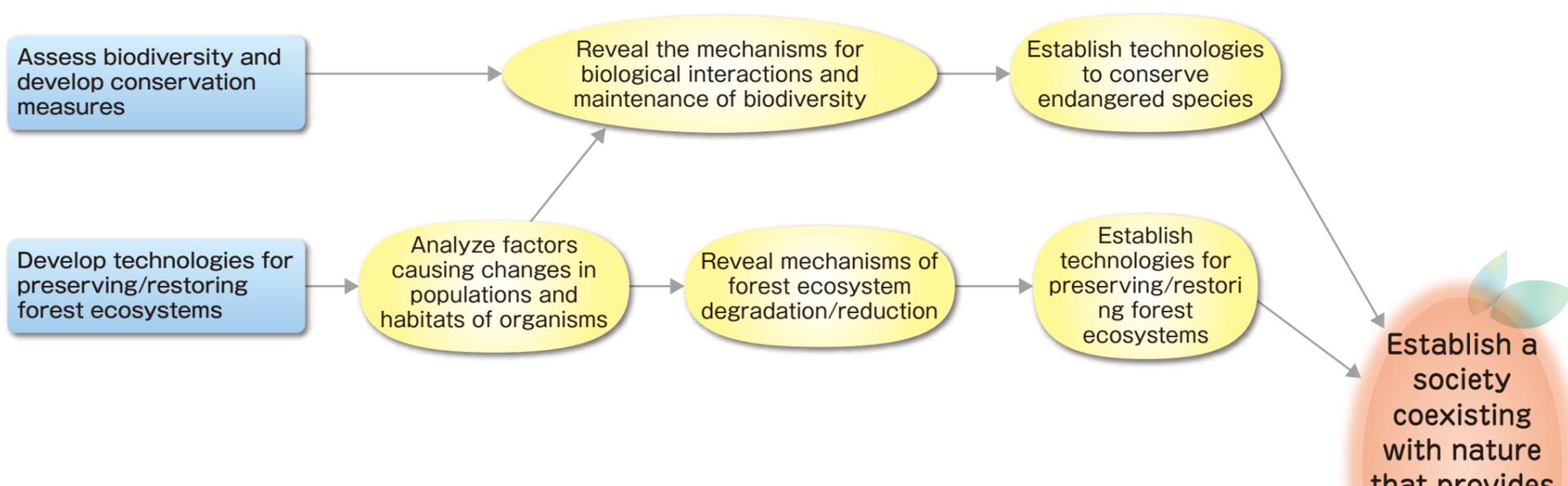
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Protect bountiful forests

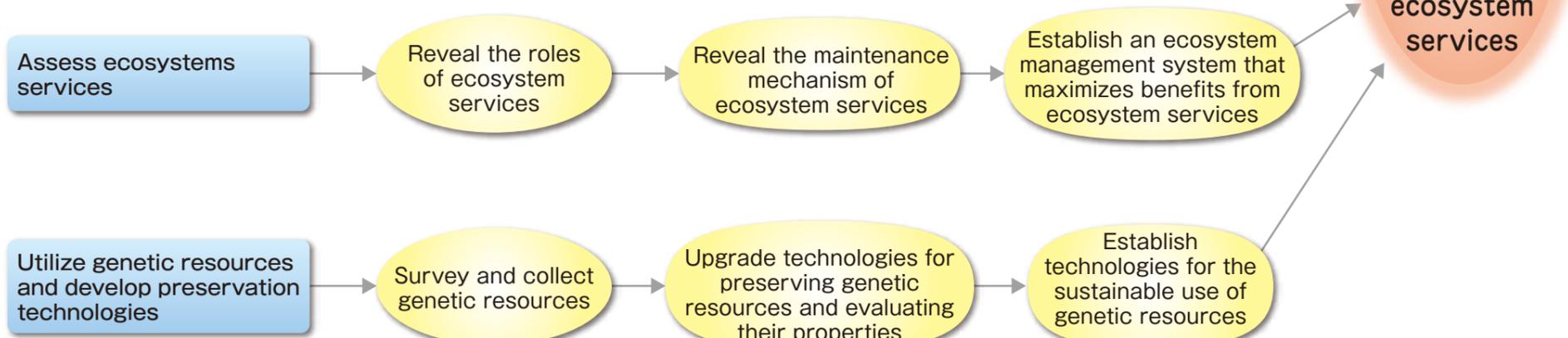
Research and Development roadmap



Technologies for conserving/restoring biodiversity



Assessment and sustainable use of ecosystem services/genetic resources



12

Maintain forest health



Forests are inhabited by diverse lifeforms. Even a dead tree gives life to other organisms that feed on it and serves as nests to birds such as woodpeckers. When a big tree falls, the light that shines through the open canopy facilitates the growth of saplings and seedlings. In forests, such circles of life have continued ceaselessly.

However, climate change and rampant socioeconomic activities by humans are expected to markedly alter the composition and living environment of organisms that constitute forest ecosystems. Moreover, concern is raised over the adverse impact on the population of endemic species, and the invasion of exotic species may pose a new risk of ecological damage. Nevertheless, a “healthy” forest will be resilient enough to recover and maintain the stability of its ecosystem even if it is subjected to temporary damage.

To preserve and maintain the forests that give us various blessings through future, we need to keep forests healthy so that they can exert their inherent resilience. To this end, FFPRI intends to monitor the damage caused by exotic invasive species, reveal the roles of forest organisms and ecosystems from varied perspectives, and develop technologies for maintaining forest health.



Technologies and measures for creating “future forests”

- Monitoring of forest health
- Management of forest health

Maintain forest health

Research and Development roadmap

2020

2030

2040

2050

Monitoring of forest health

Develop technologies for monitoring the invasion of exotic species and damage by endemic species

Construct databases and systems for detecting possibly hazardous exotic and endemic species

Construct systems for monitoring damage by exotic and endemic species

Develop diagnostic technologies for forests and trees

Establish diagnostic standards and technologies for evaluating forest and tree health

Establish systems for monitoring forest and tree health

Establish healthy and sustainable forests that provide rich natural environments.

Management of forest health

Develop technologies for mitigating damage using biological interactions

Upgrade methods for evaluating/managing damage by exotic/endemic species (full control technology)

Establish technologies/systems for managing ecological damage with minimum environmental loads

Mitigate climate change



Forests have function to absorb carbon dioxide, one of the greenhouse gases, and fix an enormous amount of carbon. Smart and efficient use of renewable wood while preventing deforestation or forest degradation will contribute to curbing greenhouse gas emissions into the atmosphere. Forests play a vital role in stabilizing global climate and protecting people's livelihoods.

As climate change advances on a global scale, temperature will rise and precipitation patterns will fluctuate in various area of the world. As the result, the growth of trees and the living environment of various organisms will be greatly affected, leading to the change in forest functions that have played for a long period.

To avoid such a scenario, FFPRI strives for the development of climate change measures through international cooperation, while developing technologies to predict the impact of climate change on ecosystems and organisms, improving technologies to track forest carbon stock and to monitor the wood resources use. FFPRI also develops technologies to adapt to possible future climate change, such as new varieties and forest practices. Through these efforts, FFPRI contributes to the conservation of healthy forests and the stabilization of the global climate.



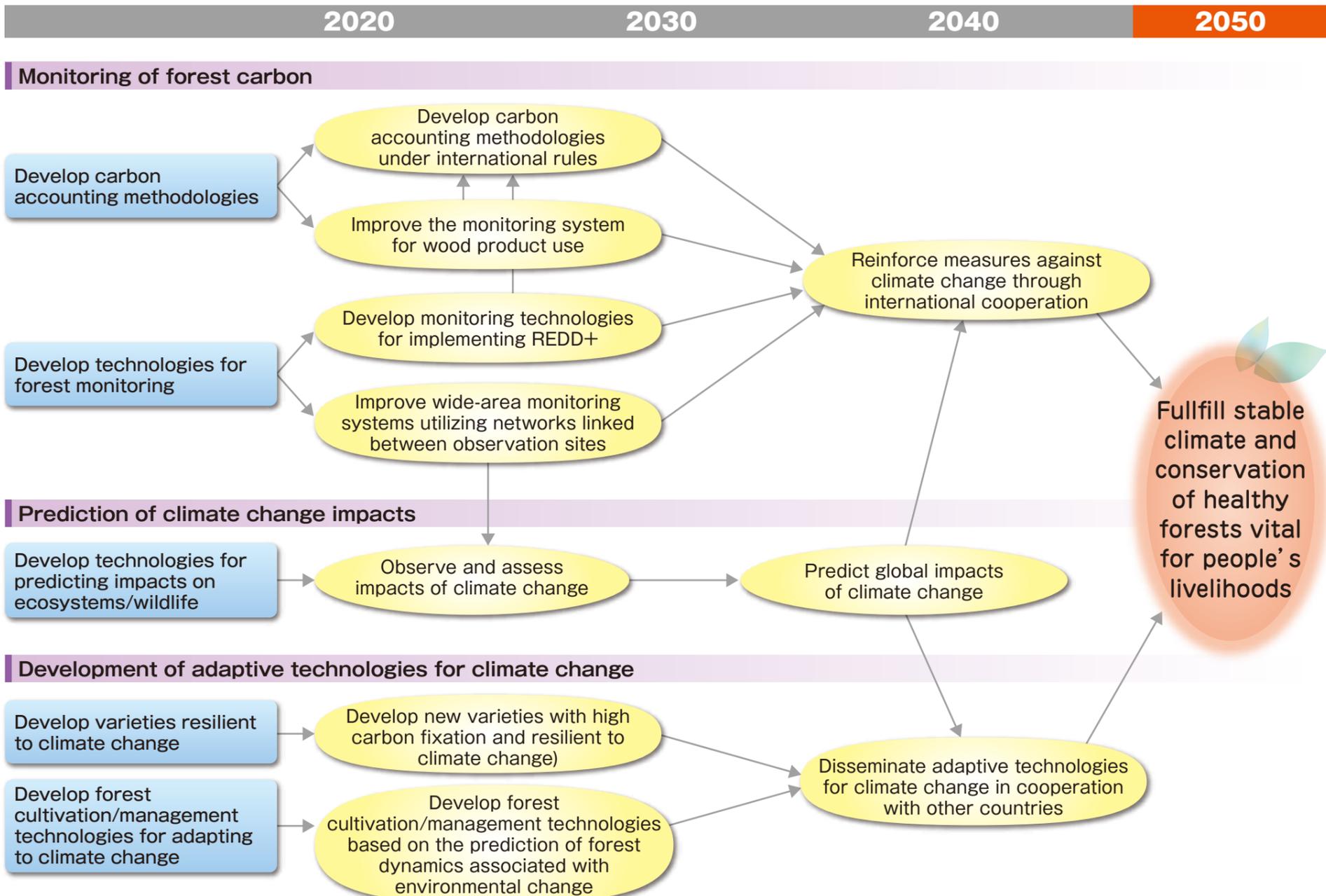
What is REDD+?
 REDD+ stands for "reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries."

Technologies and measures for creating "future forests"

- Monitoring of forest carbon
- Prediction of climate change impacts
- Development of adaptive technologies for climate change

Mitigating climate change

Research and Development roadmap



Nurture forests using new technologies

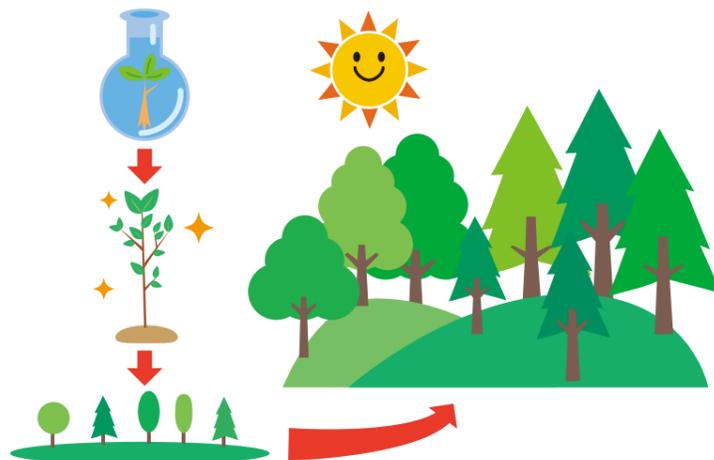


Forests perform many key functions: providing habitats for many species, preserving soil and water supplies, improving air quality, enhancing our lives and bestowing a multitude of valuable resources. To protect our earth and environment, we need to protect and nourish rich and fertile forests.

From old growth forests to artificial plantations, forests vary enormously depending on their climatic zone and soil type. Moreover, forests are subject to damage by climatic disasters and pest infestations, so effective and flexible measures are necessary to restore and reinvigorate damaged forests. Hence, FFPRI is deeply involved in research and educational activities associated with such restoration, and optimize the sensitive use of forests.

To harness forest resources sustainably and maximize forest functions, we are engaged in efforts to extend logging periods for artificial forests, convert coniferous woodlands into broadleaf forests, and introduce excellent varieties by developing technologies for creating "future forests." For example, we are developing labor-saving, flexible and mechanized silvicultural systems that will enable reliable, tailored reforestation following plantation logging. Moreover, we are helping efforts to utilize natural regeneration processes as parts of flexible forest management strategies, which are important for establishing diverse and flourishing forests.

Furthermore, the institute plans to provide new varieties that are adapted to local environments and needs, develop innovative technologies (including genetic manipulations), and foster the development of "green" factories. The ultimate aims are to establish and maintain forests with diverse properties, through the development of new forestry technologies, and enrich people's lives through environmental improvement.



What are F1 superior plus trees?
Second and later generation trees improved through cross and selective breeding.

Technologies and measures for creating "future forests"

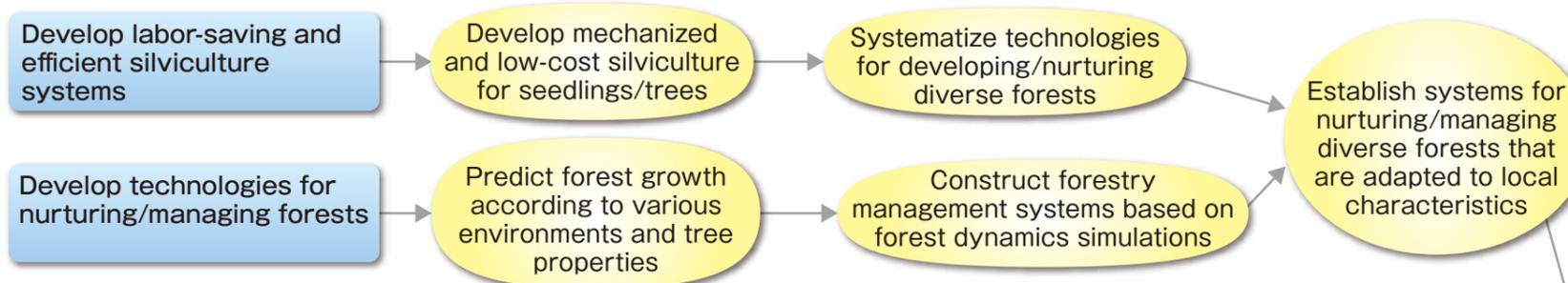
- Forestry technologies for nurturing flexible forests
- Innovative technologies harnessing useful biological properties of trees

Nurture forests using new technologies

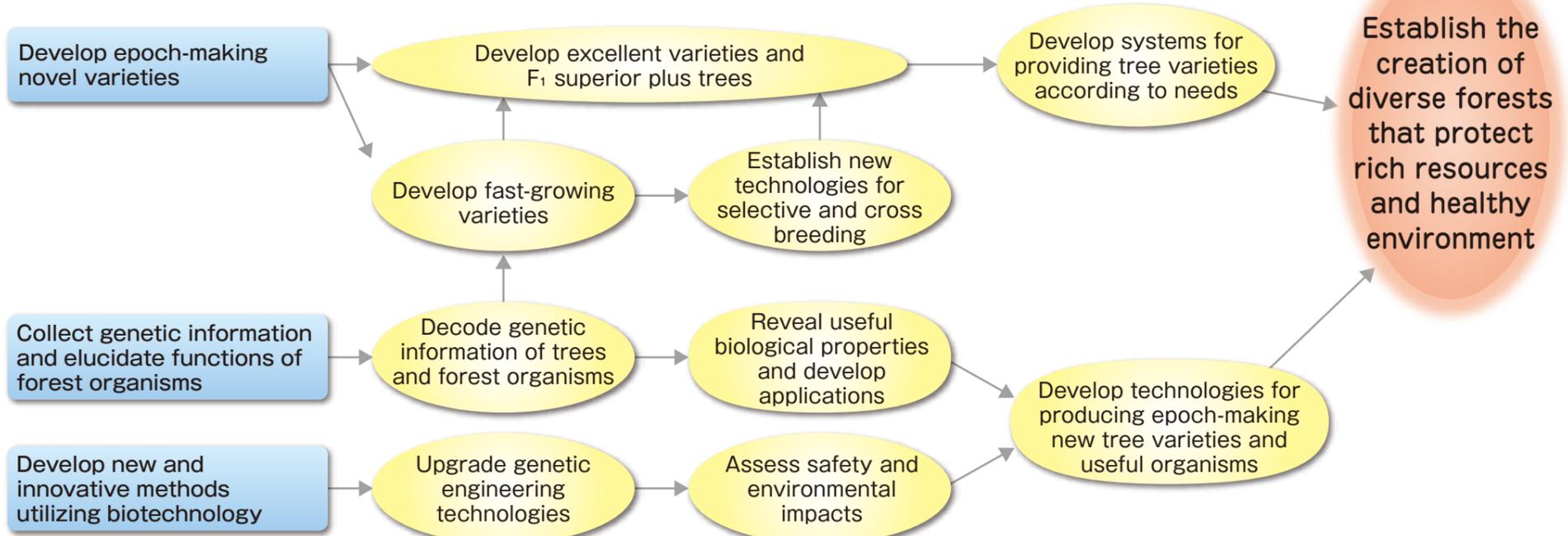
Research and Development roadmap



Forestry technologies for nurturing flexible forests



Innovative technologies harnessing useful biological properties of trees



Foster active forestry



The forestry in Japan had developed in a way that depended largely on regional circumstances, and the timber supply from forests covered the intensive needs of lumber for post-war reconstruction of the country. In recent years, however, declining wood prices and rising labor costs have put most forest managers in a predicament due to diminishing profitability.

Forests cover 67% of land in Japan; 40% of these forests are artificial forest plantations. Half of them are less than the age of 50 years that have been planted after the Second World War, and these forests are reaching the timing of harvest. With the wood self-sufficiency rate recovering the level of 30%, it is anticipated that the Japanese forestry industry will be rejuvenated through the proactive use of forest resources.

To revitalize the forestry, it is essential to establish a stable wood supply system and enhance the international competitiveness of Japanese forestry and wood industry. To this end, FFPRI aims to develop safe and efficient systems for forestry production along with ensuring profitability and factoring in varying regional conditions. Furthermore, to maintain a sustainable supply of wood, the institute intends to nurture human resources engaged in forestry and develop

novel systems for local forestry, including forest management and wood distribution.

Through these research and development efforts, the institute assists efforts to rejuvenate the Japanese forestry and revitalize regional economies.



Technologies and measures for creating "future forests"

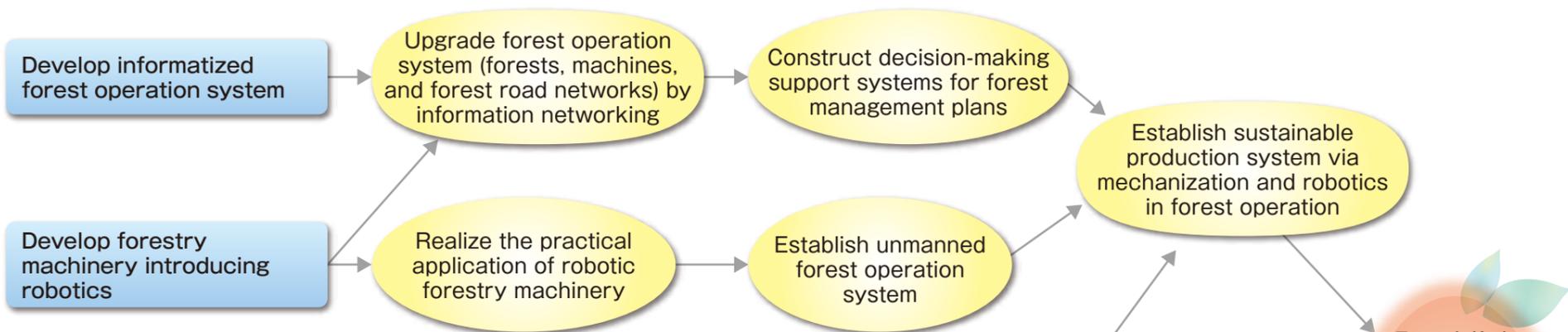
- Mechanization of forestry production systems
- Systems for managing/harnessing regional forest resources

Foster active forestry

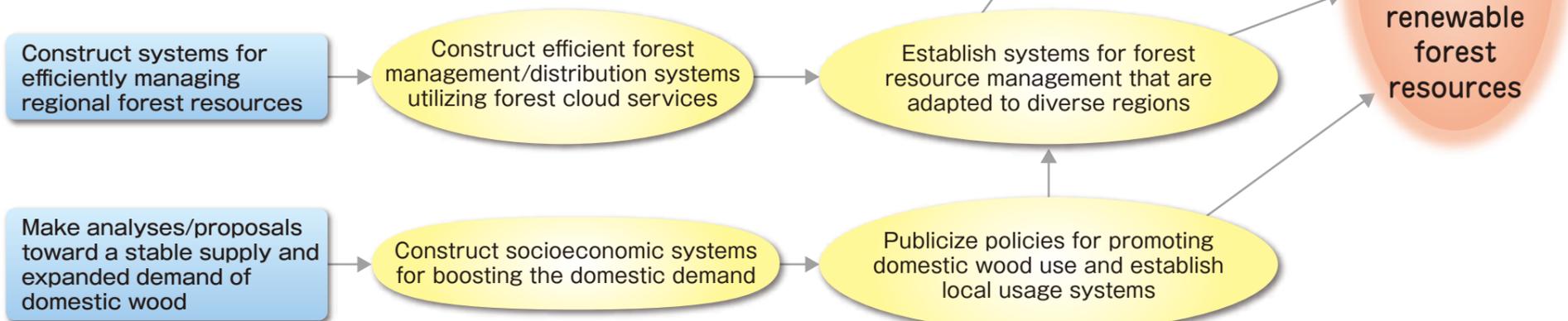
Research and Development roadmap



Mechanization of forestry production systems



Systems for managing/harnessing regional forest resources



Harness forest resources

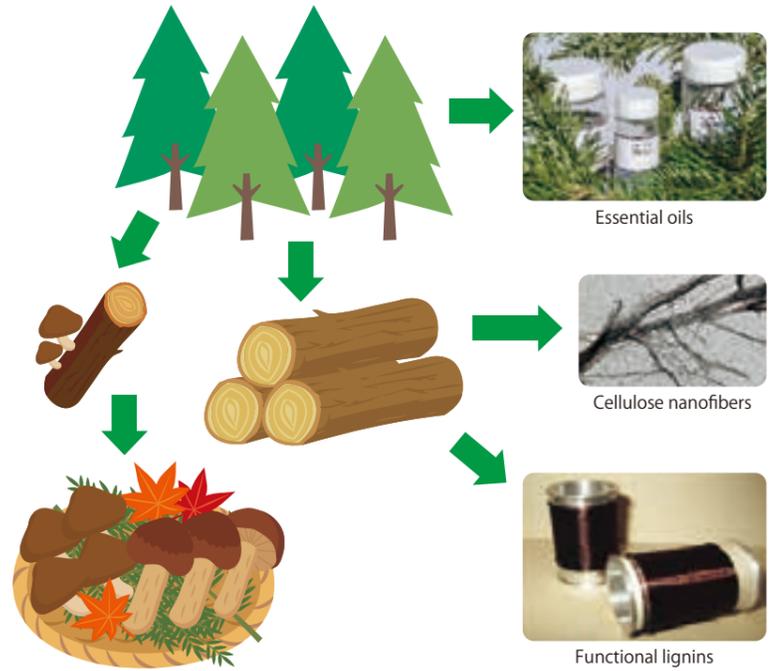


Forests are a treasure trove of biological resources that produce and recycle not only wood but also a wide variety of other useful materials. The effective use of forest resources while maintaining the forests themselves is conducive for creating an ecofriendly recycling-oriented society, revitalizing forestry, and creating new industries that harness the bounty of forests.

Biomass refers to organic matter derived from living organisms, and it is the only source of recyclable resources that can supplant petroleum resources as potential alternatives. Wooden biomass, in particular, is accumulated in abundance in the environment, and as such, its applications are attracting attention. In this context, FFPRI aims to develop application technologies that use wooden biomass as sources of energy and material. At the same time, the institute also intends to invent comprehensive systems for a stable supply and local use of woody biomass with an eye toward establishing a stable and sustainable structure for resource supply.

Forests produce diverse blessings of nature, such as mushrooms, edible wild plants, and lacquer. People have been using these natural resources since antiquity. Mushrooms are particularly high in demand and play a vital role as one of the essential commodities in rural economies. To encourage communities for making more active use of

non-wooden special forestry resources, including mushrooms, FFPRI plans to develop new technologies and varieties with the view of creating new forestry businesses.

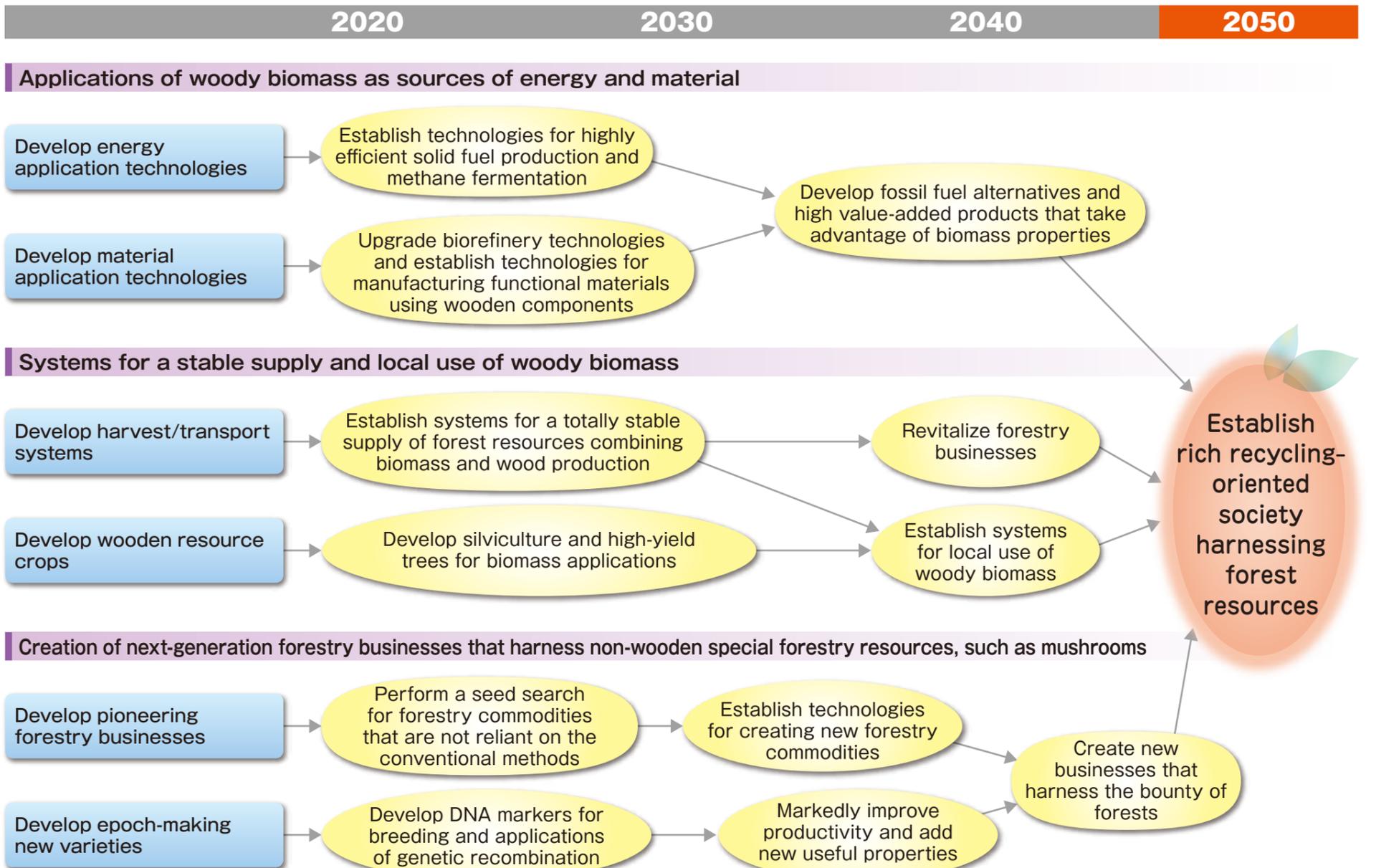


Technologies and measures for creating "future forests"

- Applications of woody biomass as sources of energy and material
- Systems for a stable supply and local use of woody biomass
- Creation of next-generation forestry businesses that harness non-wooden special forestry resources, such as mushrooms

Harness forest resources

Research and Development roadmap



Use an abundance of wood

To mitigate climate change and establish a sustainable society that does not depend on conventional fossil resources, it is essential to produce the construction and industrial materials with ecofriendly, renewable wooden alternatives.

To this end, through developing technologies to process wood materials including chemical treatments, FFPRI attempts to add multiple functions to wood products and reinforce their durability and strength. Furthermore, to utilize logs of various qualities and dimensions, the institute aims to investigate fundamental properties of wood and develop techniques for processing and quality control. Through these research and development (R&D) endeavors, the institute contributes to promote the use of wood.

FFPRI will strive to enhance the safety and comfort of wooden structures such as houses and mid- to high-rise buildings and decrease the environmental load by substantially extending their service life, thereby contributing to a disaster-resistant and comfortable living environment. In addition, the institute aims to realize a sustainable society in environmental sound ways, predicated on the use of renewable wood, by making it possible to completely reuse and recycle wooden products.

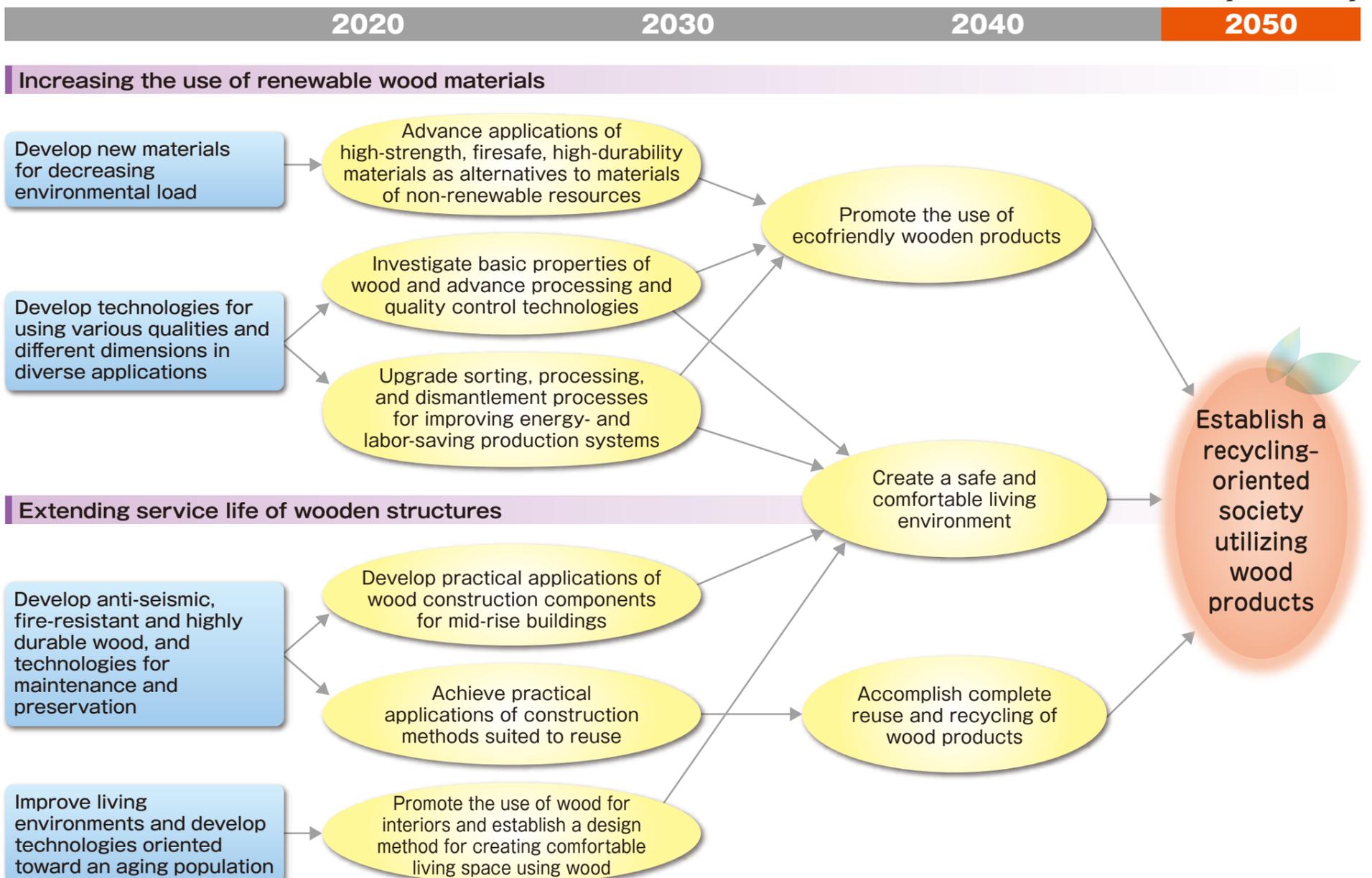


Technologies and measures for creating "future forests"

- Increasing the use of renewable wood materials
- Extending service life of wooden structures

Use an abundance of wood

Research and Development roadmap



Living with forests



● Conserve soil and water

- Monitoring of the water movement in forests
- Evaluation of the impact of climate change and forest practices
- Forecast on water balance as affected by climate change

● Prevent mountain disasters

- Forest management for maximizing disaster prevention functions
- Technologies for remote probes and terrestrial observations
- Technologies for disaster prediction and countermeasures

● Enjoy nature and enrich the mind

- Forest applications for enjoying nature
- Forest and wood applications for supporting traditional culture

Protecting forests



● Protect bountiful forests

- Technologies for conserving/restoring biodiversity
- Assessment and sustainable use of ecosystem services/genetic resources

● Maintain forest health

- Monitoring of forest health
- Management of forest health

● Mitigate climate change

- Monitoring of forest carbon
- Prediction of climate change impacts
- Development of adaptive technologies for climate change

25

Nurturing forests



● Nurture forests using new technologies

- Forestry technologies for nurturing flexible forests
- Innovative technologies harnessing useful biological properties of trees

● Foster active forestry

- Mechanization of forestry production systems
- Systems for managing/harnessing regional forest resources

26

Utilizing forests

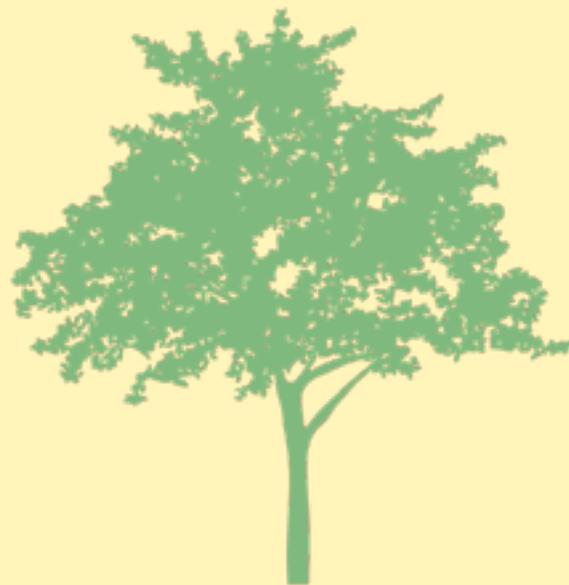


● Harness forest resources

- Applications of woody biomass as sources of energy and material
- Systems for a stable supply and local use of woody biomass
- Creation of next-generation forestry businesses that harness non-wooden special forestry resources, such as mushrooms

● Use an abundance of wood

- Increasing the use of renewable wooden materials
- Extending service life of wooden structures



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