Adaptation Communication Pursuant to Article 7, Paragraph 10 of the Paris Agreement

March 2023

The Government of Japan

Chapter 5

Vulnerability Assessment, Climate Change Impacts, and Adaptation Measures

5.1 Overview

(Institutional and legal framework for climate change adaptation measures)

- The *National Plan for Adaptation to the Impacts of Climate Change* was established and approved by the Cabinet in November 2015 (final revision: October 2021). Later, in order to define the legal position of climate change adaptation and to promote climate change adaptation more strongly in collaboration with a variety of stakeholders, including the national government, local governments, business operators, and citizens, the *Climate Change Adaptation Act* was promulgated in June 2018 and has been in force since December 2018.

(Objectives and progress management)

- The objectives of Japan's adaptation measures are to prevent and mitigate damage from the impact of climate change; to promote the stable life of citizens, sound development of society and the economy, conservation of the natural environment, and achievement of resilient national land by promoting measures related to climate change adaptation integrally and systematically based on scientific findings; and to build a safe, comfortable, and sustainable society.
- The progress of adaptation measures is to be periodically checked under the Climate Change Adaptation Promotion Council, which is chaired by the Minister of the Environment and composed of the relevant ministries and agencies.

(Major climate change impacts assessments and adaptation measures on individual sectors)

- In the *Assessment Report on Climate Change Impacts in Japan* that was published in December 2020, the impact that climate change could have on Japan is assessed for 71 categories covering seven sectors (agriculture, forestry, and fisheries; water environment and water resources; natural ecosystems; natural disasters and coastal areas; human health; industrial and economic activities; and life of citizenry and urban life) from three perspectives, including the degree and possibility of the impact (significance), the expression time of the impact, the time when adaptation efforts need to be started, and when an important decision needs to be made (urgency), and the certainty of evidence (confidence). The result of the assessment indicates that the impacts of climate change are significant and urgent.
- The *Adaptation Plan* that was revised in October 2021 sorted the climate change impacts for each category, and the basic concept of adaptation measures in consideration of the climate change impacts assessment in the aforementioned report.

(Adaptation efforts by local governments)

- In local governments, as of March 2022, 155 local governments have formulated *Local Climate Change Adaptation Plans* and are implementing adaptation measures based on local circumstances in a planned manner. As of March 2022, 47 local governments established Local Climate Change Adaptation Centers that serve as bases to collect, organize, analyze, and provide information related to local climate change impacts and climate change adaptation and to provide technical advice.

(Cross-sectoral efforts and international cooperation)

- Regarding cross-sectoral efforts, the *National Climate Change Adaptation Plan* stipulates

basic measures for the enhancement and utilization of scientific knowledge on climate change and other related issues; basic measures related to ensuring the system for collection, organization, analysis, and provision of information related to climate change; basic measures related to the promotion of measures related to climate change adaptation with local governments; basic measures related to the promotion of climate change adaptation by business operators and business activities contributing to climate change adaptation; and basic measures for securing international collaboration and promoting international cooperation related to climate change.

- Concerning international cooperation, the *National Climate Change Adaptation Plan* positions the "contribution to increasing the adaptive capacity of developing countries" as one of its basic strategies, and the national government promotes the enhancement of scientific findings related to climate change risks, the provision of stakeholders' support tools, development of capacities related to the assessment of climate change impacts and climate change adaptations through the Asia-Pacific Climate Change Adaptation Information Platform (AP-PLAT). In addition, the national government promotes technical cooperation in the observation, monitoring, projection, and assessment of climate change and its impacts, as well as DRR, climate change adaptation of agriculture, among others, and the international development of Japanese adaptation businesses using AP-PLAT and DIAS, etc.

(Other basic measures related to promoting adaptation measures)

- In 2020, a new crisis, COVID-19, emerged in addition to climate change. They are deeply connected to each other. Social changes to improve the environment, economy, and society integrally, the conservation of biodiversity, and coexistence with nature are essential to overcoming the crisis. For this reason, it is important to direct environmental policy in Japan through three transitions: the transition to a decarbonized society, the transition to a circular economy, and the transition to a decentralized society in harmony with nature, and then for local governments to develop regions newly based on the concept of a Circular and Ecological Economy, and for citizens to redesign society into one where each person changes their lifestyle. Based on these concepts, Japan is taking on various efforts.

5.2 Introduction (Noteworthy efforts in recent years)

This report is the Eighth Japan's National Communication Chapter 5, "Vulnerability Assessment, Climate Change Impacts, and Adaptation Measures", under the United Nations Framework Convention on Climate Change (UNFCCC) and the second adaptation communication of Japan to be submitted to the UNFCCC Secretariat pursuant to Article 7, paragraph 10 of the Paris Agreement. Unless otherwise noted, the information in this report reflects the situation as of March 31, 2022 (end of FY 2021 in Japan). Climate change has impacts on agriculture, forestry and fisheries, ecosystems, natural disasters, heat illness, and a variety of other areas inside and outside Japan, and the negative impacts of climate change are called a "climate crisis" shaking the foundations of human survival and the survival of all other living things.

Japan aims to reduce its greenhouse gas emissions by 46% in FY 2030 from its FY 2013 levels, setting an ambitious target that is aligned with the long-term goal of achieving net zero by 2050. Furthermore, Japan will continue strenuous efforts in its challenge to meet the lofty goal of cutting its emissions by 50%.

If a carbon-neutral 2050 is achieved globally, it will increase the possibility of limiting the rise in temperatures to 1.5°C, and it could reduce the frequency and slow the increase in strength of heatwaves, other extreme high-temperature events, and heavy rains. However, looking at the world as a whole, it is difficult to say that the prospect of achieving a carbon-neutral 2050 exists, and certain impacts may not be avoided even if the goal of limiting global warming to 1.5°C is achieved.

Therefore, it is important to strongly implement mitigation and adaptation measures in a manner complementary to each other as climate change measures.

Based on this recognition, Japan has been engaged in climate change adaptation measures. Our noteworthy efforts in recent years are stated in (1) through (8) below.

(1) Establishment of the Climate Change Adaptation Act

In 2018, Japan established a single law for the promotion of adaptation measures, the *Climate Change Adaptation Act* (hereinafter referred to as the "*Adaptation Act*"), which is rare[70] in global terms, and stakeholders are accelerating efforts for adaptation together under the Act.

(2) Implementation of climate change impacts assessment

The Ministry of the Environment assessed the impact of climate change on 71 categories covering seven sectors, such as natural disasters and human health, based on scientific findings from three perspectives –significance, urgency, and confidence– and published the *Assessment Report on Climate Change Impacts in Japan* in December 2020. A total of 1,261 reference documents were used as the basis for the report, which is approximately 2.5 times more than the previous assessment (2015) in number, and confidence increased for 31 categories. As a result, confidence was at a medium or higher degree in 55 categories (77%). Concerning significance and urgency, compared with the assessment conducted in 2015, three categories were newly assessed as "recognized as having particularly significant impacts", and eight categories were assessed as "high urgency of response." This *Assessment Report on Climate Change Impacts* will be updated approximately every five years based on the latest scientific findings.

(3) Establishment of the Climate Change Adaptation Plan by the national government

The national government organized the basic idea and concrete measures for climate change adaptation measures concerning 71 categories covering seven sectors in consideration of the *Assessment Report on Climate Change Impacts in Japan* published in December 2020, and the *National Climate Change Adaptation Plan* was approved by the Cabinet in October 2021. Under the plan, for the fields with high significance and urgency (18 major items and 32 subitems), Key Performance Indicators (KPI) are established as part of a follow-up to the plan, changes to indicators are checked every fiscal year, etc., and in this way, the progress of each measure based on the plan is identified. When the plan was being developed, one or more KPIs were set for 16 (89%) out of 18 major items, and under the plan, the goal was set to achieve 100% within five years. The *National Climate Change Adaptation Plan* is scheduled to be revised based on

[70] In a range that could be identified by a survey conducted before enforcement of the *Adaptation Act* (November 2018), Japan was the only country in the world that legislated for adaptation alone.

the revision of the climate change impacts assessment.

(4) Organization of the Climate Change Adaptation Promotion Council by relevant ministries and agencies

In order to implement the *National Climate Change Adaptation Plan* appropriately, the Climate Change Adaptation Promotion Council, which consists of the Minister of the Environment as chairperson and the relevant ministries and agencies (the Cabinet Secretariat and 12 ministries and agencies), makes the necessary coordination between relevant ministries and agencies, promotes measures related to climate change adaptation by taking a whole-of-government approach while engaging in mutual collaboration, and checks on progress periodically. In addition, a follow-up report on the *National Climate Change Adaptation Plan* is posted on the website (Japanese only: https://www.env.go.jp/earth/tekiou.html) after each meeting every year. The Council organized the first meeting in December 2018. The Ministry of Defense has been participating since the second meeting in November 2019. The meeting has been held five times in total.

(5) Establishment of local climate change adaptation plans and a Local Climate Change Adaptation Center by local governments

Prefectural governments and municipal governments are required to strive to formulate a local climate change adaptation plan based on the *Adaptation Act* in order to promote adaptation measures depending on the natural, economic, and social circumstances in their local area. As of March 2022, plans have been established in 46 out of 47 prefectural governments, and adaptation measures based on the local circumstances are being implemented systematically. Under the *National Climate Change Adaptation Plan*, which was approved by the Cabinet in October 2021, the goal has been set to achieve 100% establishment of *Local Climate Change Adaptation Plans* within five years in all prefectures and government ordinance-designated cities. The Ministry of the Environment supports the establishment of *Local Climate Change Adaptation Plans* by local governments by creating manuals and dispatching specialists to formulate plans.

In addition, prefectural governments and municipal governments are required to strive to establish a Local Climate Change Adaptation Center as a base for collecting, organizing, analyzing, and providing information related to climate change impacts and climate change adaptation and for giving technical advice based on the *Adaptation Act*. As of March 2022, Local Climate Change Adaptation Centers have been established in 37 out of 47 prefectures. Under the *National Climate Change Adaptation Plan*, the goal is set to achieve 100% establishment of Local Climate Change Adaptation Centers within five years in all prefectures and government ordinance-designated cities. The Ministry of the Environment supports efforts related to the Local Climate Change Adaptation Centers.

(6) Efforts for heat illness measures

In Japan, approximately 71,000 people were taken to hospital by ambulance for heat illness in 2019, approximately 65,000 people in 2020, and approximately 48,000 people in 2021 (for the period from June to September in 2020 and for the period from May to September in 2019 and 2021). In 2018, 1,581 people died due to heatstroke, 1,224 people in 2019, and 1,528 people in 2020 (the percentage of elderly people over 65 out of the number of all the fatalities is 80% or

higher). Taking the impact of climate change on heat illness into consideration, the national government provides weather information and Wet-Bulb Globe Temperatures (WBGT), as well as reminders, raises awareness of prevention and handling methods of heat illness, and provides appropriate information related to the occurrence status for emergencies, the education, healthcare, physical labor, agriculture, forestry and fisheries, sports, sightseeing, daily life, and other scenes in cooperation with the relevant ministries and agencies under the Heat Illness Prevention Conference. In particular, in order to have people take preventive action against heat illness, the government is operating the "Heat Stroke Alert" nationwide from April 2021, which was implemented in advance in the Kanto-Koshin region in the summer of 2020, and it continues to implement measures to prevent heat illness.

(7) Tackling weather-related disasters

In Japan, damage from weather-related disasters has become more severe in recent years. For example, as of the end of March 2022, 5 of the top 10 insurance payments (164.2 billion yen to 1,067.8 billion yen) occurred in 2018 and after.[71] In order to respond to disasters in the era of the climate crisis, drastic disaster risk reduction (DRR) measures based on climate change risks are necessary. For this reason, the Minister of the Environment and the Minister of State for Disaster Management compiled a strategy for effectively promoting coordinated measures for climate change and DRR in June 2020 in view of the achievement of the SDGs and by grasping various social issues from a broader perspective. The strategy clearly states that when recovering from a disaster, we must not be confined to simply restoring the affected area to the way it was before the disaster struck; rather, we must respond to disasters by conveying the idea of "Adaptive Recovery" by implementing resilient measures that include the control of land use where communities can ensure adaptation to climate change. Various efforts based on the strategy will continue to be implemented proactively in the future. In addition, ecosystem-based disaster risk reduction (Eco-DRR) and ecosystem-based adaptation (EbA) are implemented in consideration of the idea of nature-based solutions (NbS) and by paying attention to the fact that maintaining and restoring healthy ecosystems, including the establishment of an ecological network, contributes not only to mitigation measures by functioning as sinks for emissions but also to adaptation measures, including DRR.

(8) Efforts for international cooperation

Many developing countries generally lack the capacity to adapt to the impact of climate change. For this reason, Japan uses the Asia-Pacific Climate Change Adaptation Information Platform (AP-PLAT), which was launched to support decision-making to taking the risks of climate change into consideration and highly effective climate change adaptation in the Asia-Pacific region in order to improve scientific knowledge related to the risks of climate change, to provide stakeholder support tools, and to strengthen capacity related to the assessment of climate change impacts and climate change adaptation, in collaboration with countries and relevant institutions in the region. In addition, Japan promotes technical cooperation in the observation, monitoring, projection, assessment of climate change and its impacts, DRR, and climate change adaptation of agriculture in developing countries, with various international cooperation frameworks, meteorological satellites, etc. Furthermore, through AP-PLAT and

[71] Materials of the General Insurance Association of Japan https://www.sonpo.or.jp/report/statistics/disaster/ctuevu000000530r-att/c_fusuigai.pdf (data as of March 2022; viewed on August 3, 2022)

Data Integration and Analysis System (DIAS) etc., Japan promotes overseas development and international cooperation (*) by the government and the private sector, utilizing Japanese knowledge and experience such as technologies related to observation, monitoring, projection, and assessment of climate change and its impacts, as well as Japan's disaster experience and adaptation technology of DRR and agriculture, while promoting the international development of Japanese adaptation business.

* Among the preceding efforts, for example, the Ministry of the Environment supported the Independent State of Samoa and the Federated States of Micronesia in developing climate risk information on storm surges and high tides, which may affect their airports. Such information is expected to be used by those countries for formulating disaster prevention plans and maintenance plans for their airports. In addition, in Indonesia and Vietnam, the Ministry of the Environment supported the risk assessment of the impact of climate change on the production of paddy field rice, which is their staple diet, which resulted in the formulation of Climate Change Adaptation Plan in each country.

In addition, Japan announced in June 2021 at the G7 Cornwall Summit that Japan will provide climate finance, both public and private, totaling 60 billion USD over the next five years from 2021 to 2025 and that it will further enhance its assistance for adaptation. This is the same high level as its previous commitment up to 2020 of JPY 1.3 trillion (equivalent to approximately 11.8 billion USD) per year. This commitment stands out as a sizeable amount among other developed countries. At the COP26 World Leaders Summit held in November of the same year, Japan announced that Japan would provide up to 10 billion USD in addition to worth 60 billion USD above in order to lead the initiative in fulfilling the financial goal of climate finance that developed countries are collectively committed to the 100 billion USD per year. Japan also announced that Japan doubled its assistance for adaptation to climate change, such as disaster risk reduction, to approximately 14.8 billion USD. Under this commitment, Japan will continue to lead the global effort to tackle climate change.

Currently, under circumstances where the entire world is facing the historical crisis of COVID-19, balancing the prevention of infection with economic and social activities is a common issue around the world, including in Japan. Under the recognition that we are at a major turning point in the era, we are not required to return to the society that existed before COVID-19 but to achieve a revolution into a sustainable and resilient social system.

In addition, as recognized again in the 2030 Agenda for Sustainable Development, diverse social, economic, and environmental issues, including climate change, are inseparably linked. In order to achieve the Sustainable Development Goals (SDGs) simultaneously, it is necessary to engage in a variety of efforts comprehensively and strategically from a more inclusive perspective. For example, we need to give consideration to gender in measures against the impact of climate change, including natural disasters, and ensure the participation of women in the decision-making process related to climate change measures.

Based on the above, in Japan, cross-sectoral efforts that contribute to climate change adaptation are also being implemented proactively. We are proposing a redesign into a sustainable and resilient economic society, a Circular and Ecological Economy, Adaptive Recovery, and other new concepts, and we are engaging in efforts based on these concepts.

In this report, in addition to the aforementioned activities based on the *Adaptation Act*, these efforts related to a fundamental social change have also been introduced.

We are pleased to share the various initiatives and experiences related to adaptation that Japan has been addressing nationally with other countries through this report. Also, we expect that this report will contribute to examining various agendas in COP and the global stocktake in the near future.

5.3 Institutional and legal framework and implementation system for climate change adaptation measures

In Japan, increases in the national average temperature, increases in the frequency of heavy rain, and other long-term changes have been observed, and their diverse impacts have been reported. In the future, in association with the progress of climate change, it is projected that the risk from extremely high temperatures and heavy rain will continue to increase.

Under these circumstances, based on the *Report on Assessment of Impacts of Climate Change in Japan and Future Challenges* that was compiled as a comment submission by the Central Environment Council in March 2015, the *National Plan for Adaptation to the Impacts of Climate Change* was established and approved by the Cabinet in November 2015.

Later, in order to define the legal position of climate change adaptation and to promote climate change adaptation more strongly in collaboration among a variety of stakeholders, including the national government, local governments, business operators, and citizens, the *Adaptation Act* was promulgated in June 2018 and has been in force since December 2018.

The *Adaptation Act* consists roughly of the following four pillars:

(1) Integrated promotion of adaptation

- Defining the roles of the national government, local governments, business operators, and citizens in promoting adaptation to climate change.
- The national government shall establish a *Climate Change Adaptation Plan*.
- The Minister of the Environment shall receive the opinions of the Central Environment Council approximately once every five years and assess the impact of climate change.
- The national government shall consider a comprehensive assessment etc. of the latest impact of climate change, examine the *Climate Change Adaptation Plan*, and, if deemed necessary, promptly revise the plan.

(2) Developing information infrastructure

- The National Institute for Environmental Studies collects and provides information on the impact and adaptation of climate change and engages in operations related to technical support etc. for local governments and Local Climate Change Adaptation Centers.

(3) Enhancing local adaptation

- Prefectural governments and municipal governments strive to establish *Local Climate Change Adaptation Plans* in consideration of the *National Climate Change Adaptation Plan*.
- Prefectural governments and municipal governments strive to ensure a system that functions as a basis for collecting and providing information related to the impact of climate change and adaptation (Local Climate Change Adaptation Centers).
- Regional environment offices and other local administrative organs of the national

government, prefectures and municipalities and other entities may organize Regional Councils on Climate Change Adaptation in order to adapt to climate change through widescale collaboration.

(4) International development of adaptation and other issues

- The national government promotes international cooperation related to climate change adaptation and develops rules related to the promotion of business activities contributing to climate change adaptation by business operators.

The Japanese government has been implementing measures to reduce emissions of greenhouse gases (mitigation measures) under the *Act on the Promotion of Global Warming Countermeasures,* and the *Adaptation Act* is separate legislation for adaptation measures alone.

Based on the provisions of the *Adaptation Act*, the *National Climate Change Adaptation Plan* was established in November 2018 after coordination between relevant ministries and agencies, gathering opinions of the experts in the Global Environment Committee of the Central Environment Council and collecting and reviewing public comments.

The *National Climate Change Adaptation Plan* was followed up by the "Climate Change Adaptation Promotion Council," which was established based on the plan and consisted of relevant ministries and agencies and the progress of measures is identified and published every fiscal year. According to the latest *FY 2021 Measures Follow-up Report* published in March 2021 (Japanese only: https://www.env.go.jp/earth/tekiou.html), concerning sectoral measures and basic measures stated in the *National Climate Change Adaptation Plan*, the implementation status was inspected for each group of measures based on the details of this follow-up and previous follow-ups, and progress was confirmed to an extent in all groups of measures.

In December 2020, which was five years after the Climate Change Impacts Assessment in March 2015, a new *Assessment Report on Climate Change Impacts in Japan* was compiled based on the *Adaptation Act* in consideration of the latest scientific findings related to climate change and to the observation, monitoring, projection, and assessment of the impact of climate change in diverse fields.

In addition, in consideration of the aforementioned report, at the end of August 2021, the national government published the *Climate Change Adaptation Plan* (draft), and public comments were collected and reviewed. Subsequently, the *National Climate Change Adaptation Plan* was revised in October 2021 through specified procedures in consideration of the opinions submitted for the draft.

The matters in the following sections are stated based mainly on the *Assessment Report on Climate Change Impacts in Japan* published in December 2020 and the *National Climate Change Adaptation Plan* published in October 2021.

5.4 Objectives, basic roles of stakeholders, basic strategies, and progress management

The objectives, the basic roles of stakeholders, basic strategies, and the progress management

of Japan's adaptation measures are stipulated in the *National Climate Change Adaptation Plan* as follows.

(1) Objectives

To prevent and mitigate damage from the impact of climate change; to promote the stable life of citizens, sound development of society and the economy, conservation of the natural environment, and achievement of resilient national land by promoting measures related to climate change adaptation integrally and systematically based on scientific findings; and to build a safe, comfortable, and sustainable society. In addition to a socioeconomic perspective, such as reduction of the population and post-COVID-19, other new perspectives, including Adaptive Recovery and NbS, will be considered.

(2) Basic roles of stakeholders

Diverse stakeholders take the following basic roles, respectively and in close cooperation with each other:

A. Basic roles of the national government

Integrated promotion of climate change adaptation, taking the initiative to implement measures related to climate change adaptation, promoting and ensuring collaboration in climate change adaptation among diverse stakeholders, promoting international cooperation, enhancing and using scientific findings, and assessing the impact of climate change.

B. Basic roles of local governments

Promoting climate change adaptation based on the natural, economic, and social circumstances of the local area, the local promotion of climate change adaptation for stakeholders, and the local enhancement and use of scientific findings.

C. Basic roles of business operators

Implementation of climate change adaptation based on the characteristics of their business operations and the expansion of adaptation business.

D. Basic roles of citizens

Implementation of individual climate change adaptation actions and cooperation for climate change adaptation policy.

E. Roles to be fulfilled by the National Institute for Environmental Studies (National Research and Development Agency) related to the promotion of climate change adaptation

Observation and monitoring, climate change projection, development of information infrastructures related to climate change impacts and climate change adaptation, technical support for local governments, and technical support for Local Climate Change Adaptation Centers.

(3) Basic strategies

In order to promote measures related to climate change adaptation integrally and systematically based on scientific findings and to achieve the goals of the *National Climate Change Adaptation Plan*, basic strategies are defined as stated below. The national government and relevant ministries and agencies collaborate closely and promote sectoral and basic measures effectively under these basic strategies.

Basic strategy [i] Embed climate change adaptation in every relevant policy.

Basic strategy [ii] Promote climate change adaptation based on scientific knowledge.

Basic strategy [iii] Consolidate the knowledge of research institutions in Japan and develop the information infrastructures.

Basic strategy [iv] Promote climate change adaptation according to local backgrounds.

Basic strategy [v] Deepen the understanding of citizens and promote climate change adaptation corresponding to business activities.

Basic strategy [vi] Contribute to enhancing the adaptive capacity of developing countries.

Basic strategy [vii] Ensure a system of close collaboration among relevant administrative agencies.

(4) Progress management

In order to implement the *National Climate Change Adaptation Plan* appropriately, the national government establishes a Climate Change Adaptation Promotion Council that consists of the Minister of the Environment as chairperson and relevant ministries and agencies, make the necessary coordination among relevant ministries and agencies under the Council, promotes measures related to climate change adaptation together by taking a whole-of-government approach while collaborating with each other, and checks the progress periodically.

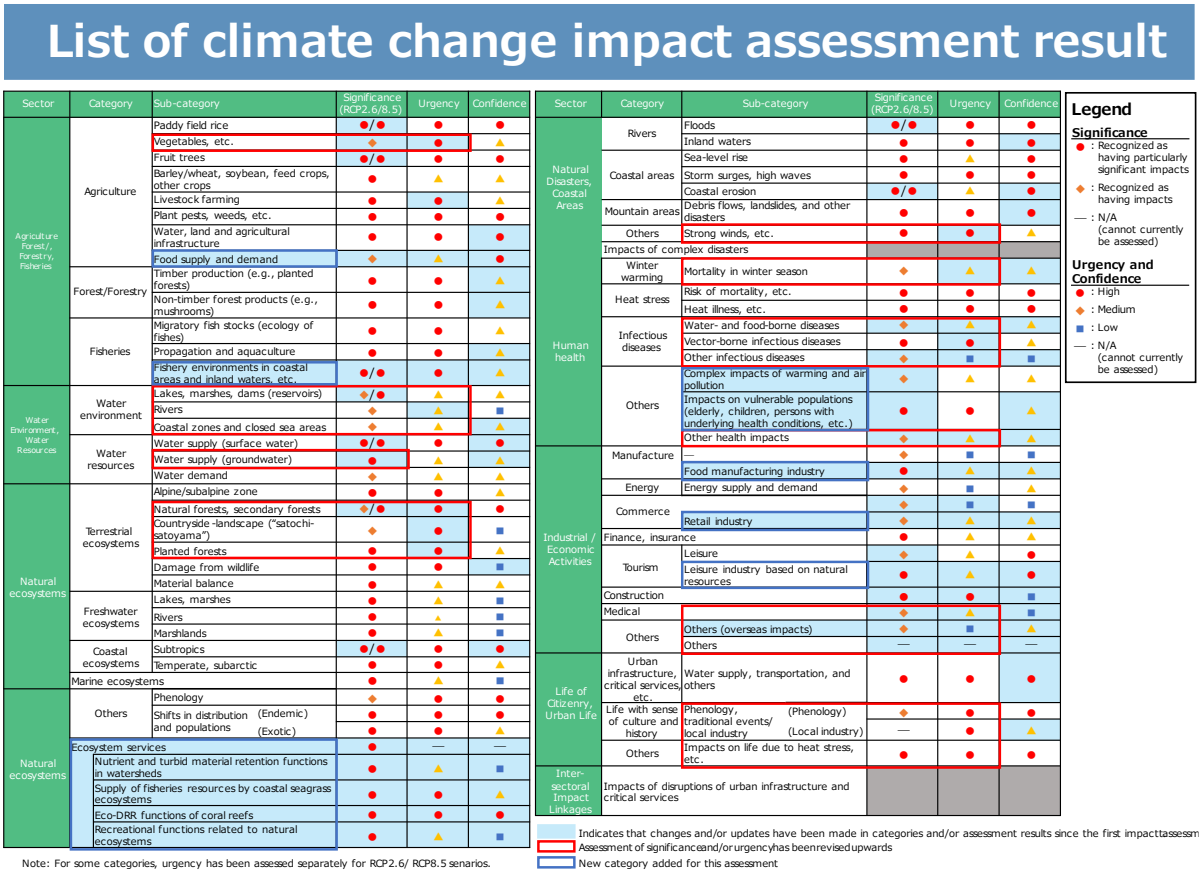
A PDCA method is introduced for managing the progress of sectoral and basic measures. In concrete terms, the progress of short-term measures is managed by implementing a follow-up review every fiscal year using KPI. In addition, indicator data will be broadly collected. Concerning basic measures, the progress of medium- and long-term climate change adaptation is checked every five years.

PDCA methods are revised as necessary, and the methods to identify and assess the impact of adaptation measures are examined.

5.5 Major climate change impact assessments and basic concept of adaptation measures on individual sectors

In the *Assessment Report on Climate Change Impacts in Japan* that was published in December 2020, the impact that climate change could have on Japan is assessed for 71 categories covering seven sectors based on scientific knowledge from three perspectives, including the degree and possibility of the impact (significance), the expression time of the impact, the time when adaptation efforts need to be started and when an important decision needs to be made (urgency), and the certainty of evidence (confidence). The outline is as stated below.

Table 5-1 Results of climate change impact assessments (Summary)



List of climate change impact assessment result

Sector	Category	Sub-category	Significance (RCP2.6/8.5)	Urgency	Confidence
Agriculture Forest/, Forestry, Fisheries	Agriculture	Paddy field rice	●/●	●	●
		Vegetables, etc.	◆	●	▲
		Fruit trees	●/●	●	●
		Barley/wheat, soybean, feed crops, other crops	●	▲	▲
		Livestock farming	●	●	▲
		Plant pests, weeds, etc.	●	●	●
		Water, land and agricultural infrastructure	●	●	●
		Food supply and demand	◆	▲	●
	Forest/Forestry	Timber production (e.g., planted forests)	●	●	▲
		Non-timber forest products (e.g., mushrooms)	●	●	▲
	Fisheries	Migratory fish stocks (ecology of fishes)	●	●	▲
		Propagation and aquaculture	●	●	▲
		Fishery environments in coastal areas and inland waters, etc.	●/●	●	▲
Water Environment, Water Resources	Water environment	Lakes, marshes, dams (reservoirs)	◆/●	▲	▲
		Rivers	◆	▲	■
		Coastal zones and closed sea areas	◆	▲	▲
	Water resources	Water supply (surface water)	●/●	●	●
		Water supply (groundwater)	●	▲	▲
		Water demand	◆	▲	▲
Natural ecosystems	Terrestrial ecosystems	Alpine/subalpine zone	●	●	▲
		Natural forests, secondary forests	◆/●	●	●
		Countryside -landscape ("satochi-satoyama")	◆	●	■
		Planted forests	●	●	▲
		Damage from wildlife	●	●	■
		Material balance	●	▲	▲
	Freshwater ecosystems	Lakes, marshes	●	▲	■
		Rivers	●	▲	■
		Marshlands	●	▲	■
	Coastal ecosystems	Subtropics	●/●	●	●
		Temperate, subarctic	●	●	▲
	Marine ecosystems		●	▲	■
Natural ecosystems	Others	Phenology	◆	●	●
		Shifts in distribution and populations (Endemic)	●	●	●
		Shifts in distribution and populations (Exotic)	●	●	▲
	Ecosystem services		●	—	—
		Nutrient and turbid material retention functions in watersheds	●	▲	■
		Supply of fisheries resources by coastal seagrass ecosystems	●	●	▲
		Eco-DRR functions of coral reefs	●	●	●
		Recreational functions related to natural ecosystems	●	▲	■

Note: For some categories, urgency has been assessed separately for RCP2.6/ RCP8.5 senarios.

Sector	Category	Sub-category	Significance (RCP2.6/8.5)	Urgency	Confidence
Natural Disasters, Coastal Areas	Rivers	Floods	●/●	●	●
		Inland waters	●	●	●
	Coastal areas	Sea-level rise	●	▲	●
		Storm surges, high waves	●	●	●
		Coastal erosion	●/●	▲	●
	Mountain areas	Debris flows, landslides, and other disasters	●	●	●
	Others	Strong winds, etc.	●	●	▲
Impacts of complex disasters					
Human health	Winter warming	Mortality in winter season	◆	▲	▲
	Heat stress	Risk of mortality, etc.	●	●	●
		Heat illness, etc.	●	●	●
	Infectious diseases	Water- and food-borne diseases	◆	▲	▲
		Vector-borne infectious diseases	●	●	▲
		Other infectious diseases	◆	■	■
	Others	Complex impacts of warming and air pollution	◆	▲	▲
		Impacts on vulnerable populations (elderly, children, persons with underlying health conditions, etc.)	●	●	▲
		Other health impacts	◆	▲	▲
Industrial / Economic Activities	Manufacture	—	◆	■	■
		Food manufacturing industry	●	▲	▲
	Energy	Energy supply and demand	◆	■	▲
	Commerce		◆	■	■
		Retail industry	◆	▲	▲
	Finance, insurance		●	▲	▲
	Tourism	Leisure	◆	▲	●
		Leisure industry based on natural resources	●	▲	●
	Construction		●	●	■
	Medical		◆	▲	■
	Others	Others (overseas impacts)	◆	■	▲
		Others	—	—	—
Life of Citizenry, Urban Life	Urban infrastructure, critical services, etc.	Water supply, transportation, and others	●	●	●
	Life with sense of culture and history	Phenology, traditional events/ local industry (Phenology)	◆	●	●
		Traditional events/ local industry (Local industry)	—	●	▲
	Others	Impacts on life due to heat stress, etc.	●	●	●
Inter-sectoral Impact Linkages	Impacts of disruptions of urban infrastructure and critical services				

Indicates that changes and/or updates have been made in categories and/or assessment results since the first impacttassessm
Assessment of significanceand/or urgencyhas beenrevisedupwards
New category added for this assessment

Legend

Significance
- ● : Recognized as having particularly significant impacts
- ◆ : Recognized as having impacts
- — : N/A (cannot currently be assessed)

Urgency and Confidence
- ● : High
- ◆ : Medium
- ■ : Low
- — : N/A (cannot currently be assessed)

The *National Climate Change Adaptation Plan* that was revised in October 2021 sorted the climate change impacts for each category and the basic concept of adaptation measures in consideration of the climate change that impacts the assessment in the aforementioned report.

In the following, the impact of climate change and the basic concept of adaptation measures are organized based on the statements in the *Assessment Report on Climate Change Impacts in Japan* and the *National Climate Change Adaptation Plan*. Concerning the basic concept of adaptation measures, concepts related to subcategories for which the significance, urgency, and confidence are all assessed to be high are excerpted and indicated as examples, while climate change impacts assessments related to sectors that include such subcategories are excerpted and indicated as examples, respectively. For details on basic concepts related to adaptation measures for other subcategories, a detailed assessment of the impact of climate change and the methods and scenarios used for projections on individual sectors, please refer to the latest *Assessment Report on Climate Change Impacts in Japan* and the *National Climate Change Adaptation Plan*.

http://www.env.go.jp/earth/tekiou.html (Japanese)
http://www.env.go.jp/en/earth/cc/adaptation.html (English).

5.5.1 Agriculture, forestry, and fisheries

■ Overview of climate change impacts

(1) Current status

In agriculture, the quality and yields of many crops have seen declines nationwide in Japan due to changes such as increased temperatures and changes in the temporal and spatial distribution of precipitation, with decreases in the ratio of first-class rice produced, poor growth of vegetables, and physiological disorders of fruit trees; the effects of heat stress are also becoming increasingly evident in the livestock sector. Crop damage is occurring because of the expanded distribution and increased outbreaks of pests and diseases. In the water, land, and agricultural infrastructure, the lack of rain and other factors are leading to shortages in agricultural water that impact agricultural water supply facilities. In relation to forestry activities, disease outbreaks in shiitake mushroom bed log cultivation are becoming prevalent in larger areas. In fisheries, there have been changes in the distribution areas of migratory species, such as the Japanese flying squid and Pacific saury (*samma* in Japanese), impacting the processing and distribution industries, as well as increased risk of fish and shellfish mortality in aquaculture and inland fisheries and decreased yields in seaweed production. There is also a serious decline in seaweed beds, believed to be due to increased seawater temperatures. Conversely, there have been reports of increased yields of crops, such as feed corn, in some areas, expansion of areas suitable for fruit tree cultivation (e.g., wine grapes), and increased fish catches (e.g., Japanese yellowtail [*buri*] and Japanese Spanish mackerel [*sawara*]). In addition, some reports have described impacts on production methods in response to climate change, especially in agriculture, with adaptation measures already being implemented for certain crops, such as growing heat-tolerant cultivars and making modifications to growing seasons.

(2) Projected impacts

A variety of approaches are being used for future projections, including research using greenhouse gas emissions and concentration scenarios, research that takes uncertainty into account using multiple climate prediction models, field experiments, and research that reflects cultivation test results in plant growth models etc. In subcategories, such as paddy field rice, fruit trees, and fishery environments in coastal areas and inland waters, new findings have been reported related to future projections using RCP2.6 and RCP8.5 scenarios. In agriculture, it has been suggested that yields will decrease for paddy rice, fruits and vegetables, fall wheat, soybean in warm regions, tea, etc.; it has been predicted that a greater ratio of paddy rice will become more susceptible to high-temperature risk; for fruit trees, there are projections for deterioration of grape coloration and changes in suitable growing areas for fruit, such as satsuma mandarin oranges and apples. In addition, decreases are predicted in livestock growth, increases in pest outbreaks and habitat area, and increases in damage resulting from disease. For the water, land, and agricultural infrastructure, a lack of agricultural water is predicted for some areas because of the decrease in snowmelt runoff during the wet-ploughing (*shirokaki*) season for paddy rice cultivation and an increased risk of damage to low-lying paddy fields due to heavy rainfall. In forestry, research is underway to estimate the net primary production of Japanese cedar (sugi) planted forests for shiitake bed log cultivation, and the earlier or more frequent occurrence of pests for shiitake is predicted. In fisheries, in the waters around Japan, the distribution is predicted to shift and expand for Japanese sardines (also known as pilchard; *maiwashi*) and Japanese amberjack, while the salmon and trout habitat is expected to decrease, and the larger marine areas are expected to see lower distribution densities of Japanese flying

squid. In aquaculture, some areas that produce fish and shellfish are expected to become unsuitable for production because of increased water temperatures in summer. For seaweed, the habitat for kelp (kombu) is expected to move significantly northward, the harvest season for wakame seaweed to be shortened, the start of seedling raising for nori seaweed growing to be delayed, and the variety of seaweed types in seaweed beds along the coast of Japan to decrease.

Basic approach to adaptation measures

(a) Overview of agricultural production

- Although impact projection has been conducted with a focus on major crops, it is necessary to conduct further research on projected impacts.

(b) Paddy field rice

- Because of the high temperatures after the ear emergence period, high-temperature disorders causing immature white grains to occur frequently were often observed. Therefore, it is necessary to strive to avoid high temperatures during the grain ripening period by introducing high temperature-resistant varieties or by planting varieties with various ripening periods.
- The early onset of pests, increases in pest emergence volume, and an expansion in the areas where pests occur have been seen because of the impact of global warming. Therefore, appropriate pest control measures need to be implemented.

(c) Fruit trees

- Fruit trees are perennial crops, which require a certain period to produce fruit, and may easily cause price fluctuations because of a loss in the balance of supply and demand. Therefore, it is essential to introduce more measures from a long-term perspective than for other crops. Consequently, a network system between major production sites and major prefectures must be developed so that information related to the impact of global warming and its adaptation measures are shared, and action plans are appropriately examined in production site.
- Strive to disseminate the spraying of gibberellin combined with prohydrojasmon that mitigate the occurrence of peel puffing with satsuma mandarin oranges, the introduction of sprinkling water and reflective sheets as measures against poor coloring and sunburned fruit with apples, production stabilizing technologies of girdling to mitigate the coloring of grapes, the utilization of a sprout promoter for the purpose of mitigating damage caused by poor sprout emergence with Japanese pears, and other measures.
- In addition, promote demonstrations etc. on changing items from satsuma mandarin oranges to medium-late ripening citrus fruits, changing to superior-colored varieties of apples and grapes, introducing highly valuable subtropical and tropical fruits, and other measures.

(d) Plant pests, weeds, etc.

- In order to prevent the emergence of plant pests in Japan, promote pest control at an appropriate time based on pest forecasting information, early detection and control of invasive pest, and strengthening measures on plant movement restrictions, as well as advancing pest control techniques.

- With regard to mycotoxins, investigate the contamination status and continue to engage in establishing and disseminating measures to improve safety in cooperation with producers and validating the effects after a specified period.
- Concerning weeds, promote the development of technology to mitigate damage.

(e) Water, land and agricultural infrastructure

- In order to respond appropriately to more frequent and intense rainfall and other disasters and to achieve stable farming, as well as safe and comfortable lives in villages, promote the lifespan extension of farm irrigation facilities etc., water-resistant measures, the establishment of emergency power sources, or other tangible measures by combining them appropriately with the creation of hazard maps by conducting activities to raise awareness for local residents or other intangible measures based on the Fundamental Plan for National Resilience (approved by the Cabinet in June 2014; revised in December 2018) and the Basic Plan for Food, Agriculture and Rural Areas (approved by the Cabinet on March 31, 2020).

5.5.2 Water environment and water resources

■ Overview of climate change impacts

(1) Current status

In the water environment sector, newly observed impacts include increases in water temperatures already occurring in public waters (lake, marshes, rivers, seas) all over Japan, including a warming trend in water temperatures at 76% (summer) and 94% (winter) of 265 monitoring sites nationwide, and associated changes in water quality, as well as increases in the temperature of the water, and increased temperatures of spring water in spring-fed ponds. In the water resources sector, there have been reports of such impacts as water restrictions being imposed because of water shortages associated with the absence or lack of rain, the lack of irrigation water in spring due to an increase in snow melt during winter and increased agricultural and urban water demand. In terms of newly reported impacts, some examples include saltwater intrusion in coastal aquifers and the contraction of small island freshwater lenses.

(2) Projected impacts

Projected impacts in the water environment sector include more reservoirs being classified as being eutrophic water bodies, increased water temperatures and salinity concentrations in Lake Shinji and Nakaumi (brackish lakes in Shimane and Tottori prefectures), increased aquifer temperatures on the Sendai Plain, increased water temperature in the Seto Inland Sea and Ise Bay, and longer periods of turbid water discharge due to increases in suspended particulates associated with higher inflows into four reservoirs in the Tohoku region. Projected impacts in the water resources sector include more severe droughts due to an increase in rainless days, the increased river flows in winter due to a shift from snowfall to rain, decreased river flows in spring due to decreased snow melt, decreases in river flow during demand periods due to early snow melt, impacts on domestic water use by citizens in Sapporo due to future decreases in water resources, a mismatch between supply and demand for agricultural water due to dropping groundwater levels, etc., saltwater intrusion extending further upstream due to sea level rise, and because of that, impacts of the utilization of river water, a growing tendency for

polarization of drought risk and flood risk, and the occurrence of landslides and other slope disasters due to increased groundwater supply as a result of heavy rainfall and snow melt.

■ Basic approach to adaptation measures

(a) Water supply (Surface water)

- Conduct assessments of water supply safety levels and drought risks for existing facilities that are the basis of measures to prevent and mitigate damage from droughts and prepare for droughts through drought risk information sharing with collaboration among actors, including the national government, local governments, water users, companies, and residents.
- In order to promote adaptation measures to deal with droughts, in collaboration with stakeholders, develop scenarios of drought impacts and damage and promote efforts to formulate drought response action plans that are time series and stipulate matters, including measures to mitigate damage from droughts.

5.5.3 Natural ecosystems

■ Overview of climate change impacts

(1) Current status

Impacts already occurring that have been reported around the country include long-term changes in species composition in forests near alpine and vegetation transition zones, seasonal mismatches between plant flowering seasons and pollinators, nationwide increases in sika deer habitat, and northward movement of the distribution of southern species in the river and coastal ecosystems. Newly appearing impacts include expansion near the northern limit of distribution of moso bamboo and Japanese timber bamboo over the past 30 years, a decline of seaweed bed ecosystems and a transition to coral reef communities in coastal areas, and further ocean acidification and oxygen depletion nationwide.

(2) Projected impacts

Projected impacts include the nationwide reduction or local disappearance of suitable habitat for such species as alpine ptarmigan and such cold-water fish as char, shifts in the distribution and growth of forest constituent tree species, expanded distribution of sika deer and bamboo species to higher latitudes and elevations, reduction or disappearance of suitable areas for the distribution of coral reefs in subtropical zones, a transition from seaweed bed ecosystems to coral reefs in temperate zones, and decreases in suitable habitat for species of coral, sea urchin and shellfish due to further ocean acidification. In subcategories, such as natural forests, secondary forests, and the subtropics (coastal ecosystems), new findings have been reported related to future projections using RCP2.6 and RCP8.5 scenarios.

Other changes being predicted include negative socioeconomic ripple effects due to impacts on ecosystem services, such as the reduced supply of fisheries resources due to reductions in the nutrient and turbid material retention functions in watersheds and the deterioration and disappearance of seaweed bed ecosystems in coastal areas, reductions in ecosystem-based disaster risk reduction (Eco-DRR) function due to the deterioration and disappearance of coral reefs, and reduced recreational functions associated with natural ecosystems.

Basic approach to adaptation measures

(a) Common efforts

- Ecosystems as a whole will change in response to climate change. Therefore, it is impossible to control ecosystem changes extensively by anthropogenic measures. In addition, it is necessary to recognize that ecosystem conservation functions as an adaptation measure for the aforementioned issues in agriculture, forestry, and fisheries.
- The basic adaptation measures in natural ecosystems are to identify changes in the ecosystems and species by conducting long-term continuous monitoring or other investigations, to look at sources of stress from non-climate change factors in addition to stress from climate change factors, to reduce these sources of stress, and to build an ecological network between protected areas and other effective area-based conservation measures and thereby promote the conservation and recovery of healthy ecosystems that are highly adaptable to climate change.
- In particular, it is also important to promote the strengthening of conservation and management in the areas that are expected to contribute to the adaptation in natural ecosystems (areas into which organisms can retreat or survive [refugium] under climate change and areas that can be sources of the supply of individuals), expanding whole areas, securing connectivity, and measures for using the natural environment to prevent lowland organism species from expanding unnecessarily into highlands.
- When building ecological networks, it is important to increase the connectivity and soundness of ecosystems from both a country-wide geographical perspective and a local perspective in order to establish a resilient country against environmental changes due to climate change etc.
- From the broader geographical perspective, in consideration of the fact that it was determined to support new global targets to conserve or protect at least 30% of global land and at least 30% of the global ocean by 2030 and to lead by example, effectively conserving or protecting at least the same percentage in theG7 nations, in the G7 2030 Nature Compact, which was adopted by the G7 Summit in 2021, it is necessary to expand protected areas and establish other effective area-based conservation measures in the most effective sites and to improve the quality of these areas in order to maintain the sustainability of ecosystem services by connections between forests, countryside, rivers, and sea.
- From the local perspective, methods to increase the quality of local ecosystems in supporting the life cycle of a living organism, such as securing diverse habitats and food resources. In particular, insects are fundamental in supporting ecosystems through their biomass and pollination and are important for the resilience of ecosystems. Therefore, it is also important to support the life cycles of these species in small green spaces in cities, farmland in villages and village forests, and other familiar natural environments.
- Active intervention may be conducted to maintain ecosystems, species, and ecosystem services to a limited extent; however, very careful study is necessary given the impact on ecosystems etc. and the burden of management. The creation of refugium has been considered to avoid impacts on ecosystems; however, there are species that can be transferred quickly and others that cannot be transferred with the effects varying by species. Therefore, careful attention must be paid. In addition, it is important to examine other measures based on the expected effects.

- When examining adaptation measures, it is important to collect basic information on subject regions/local areas, determine assessment indicators for existing visible impacts or expected impacts, project future impacts, and then establish measures based on the results, as well as to establish a plan related to the use and conservation based on local circumstances through discussions with local stakeholders, build consensus, and take action comprehensively in collaboration while sharing roles. When establishing measures, it is necessary to examine options based on whether the impact of climate change is projected for the distribution of species to be conserved in subject areas and other species that have an adverse impact on the species to be conserved and whether there is a refugium, etc. In addition, when implementing measures, it is necessary to monitor changes in the subjects of assessments and to engage in adaptive management to review the plan regularly. It is also necessary to foster human capital that is involved in the management and research, and studies of the natural environment from the long-term perspective in order to implement adaptation measures appropriately and effectively.
- Perspectives to maximize synergy and minimize tradeoffs with biodiversity conservation are important. The functions performed by healthy ecosystems include DRR, mitigation of heat stress in cities, and actions against the degradation of water quality in coastal areas and enclosed water areas, and they also contribute to adaptation measures in various fields. This concept is called Ecosystem-based Adaptation (EbA) or Ecosystem-based Disaster Risk Reduction (Eco-DRR) as part of NbS, and it is important as an effort that provides multiple benefits. In particular, in order to increase local resilience, it is necessary to avoid land use that is vulnerable to natural disasters based on the local landscape and ecosystem conditions to encourage a shift in residency from areas with high disaster risks to areas with low risks and to strengthen the local disaster resilience using the diverse functions of the natural environment.
- The impact of climate change is highly uncertain and advances over the long term. Therefore, it takes time before obvious changes are seen in the distribution and abundance of species and ecosystem services etc. These changes need to be defined from a long-term perspective, and it is impossible to judge the impact based on short-term monitoring results alone. For this reason, it is necessary to continue long-term monitoring and other investigations and to enhance and expand them as necessary.
- Concerning items with low confidence, study cases are limited, and there are anthropogenic impacts and impacts from land use. Therefore, it is necessary to accumulate scientific findings by promoting investigation and research to identify the impact of climate change on biodiversity etc. and to transmit and share appropriate information.

(b) Terrestrial ecosystems (Natural forests / Secondary forests)

- Concerning forests, it is necessary to promote the conservation and management of virgin forests and forests where rare wild organisms live and grow, as well as promote research and studies on the impact of climate change on forests.
- In order to conserve and restore sound ecosystems that are highly adaptive to climate change, it is necessary to promote the creation of an ecological network for the entire country between protected areas and other effective area-based conservation measures and to implement measures against the loss of biodiversity due to non-climate change factors that have been implemented by setting priorities in consideration of the perspective of adaptation to climate change.

- In particular, activities to strengthen the conservation of areas that are expected to mitigate the impact of climate change and to prevent lowland species from expanding to highlands are important.

(c) Coastal ecosystems (Subtropics)

- It is necessary to implement intensive long-term monitoring and other investigations with tidal flats, salt marshes, seaweed beds, seagrass beds, and coral reefs, where there is an especially high likelihood of impacts occurring. In addition, coastal areas have a strong relationship with the land through rivers etc. Therefore, it is necessary to expand observation through the entire river basin.
- In order to conserve and reproduce sound ecosystems that are highly adaptive to climate change, it is necessary to ensure the continuity of coastal ecosystems mainly by effectively allocating Marine Protected Areas etc. with various purposes, to form ecological networks, and to implement measures against the loss of biodiversity due to non-climate change factors that have been implemented, by setting priorities in consideration of the perspective of climate change adaptation.

(d) Shifts in distribution and populations (native species)

- In consideration of the perspective that changes in ecology and climate change provide useful basic data for investigations etc. of the impact on ecosystems and in consideration of the perspective that they have a cultural value in sensing the four seasons through living things, it is necessary to implement monitoring and other investigations to identify changes in phenology, including Citizen science.
- In order to identify changes in the distribution areas of species and populations, it is necessary to implement continuous long-term monitoring and other investigations.
- In order to secure routes for species to move and spread, it is necessary to promote the creation of ecological networks between protected areas and other effective area-based conservation measures and to implement measures against the loss of biodiversity due to non-climate change factors that have been implemented by setting priorities in consideration of the climate change adaptation perspective.
- Based on information obtained from monitoring and new scientific findings, it is necessary to take the appropriate action concerning species that risk causing adverse ecological impacts by considering climate change impacts when assessing invasive alien species.

(e) Ecosystem services (Eco-DRR function of coral reef)

- In addition to quantitative assessment and visualization of the various social benefits of NbS and other ecosystem services, it is necessary to promote investigation and research of the changes in the benefits and social impacts of climate change and to gather scientific findings to examine efforts for sustainable ecosystem services. In addition, it is necessary to promote the implementation of regional efforts.
- In the future, based on the fact that the impact on pollination services caused by changes in the distribution of pollinating insects due to climate change and mismatches between the visitation of pollinating insects and plant blossoming times, it is important to secure habitat size and continuity even for common species.

5.5.4 Natural disasters, coastal areas

■ Overview of climate change impacts

(1) Current status

There are reports on the occurrence of the following: vertical ground movement, a rising sea level trend that has been analyzed with corrections for air pressure and tides; extreme storm surges due to tropical cyclones; multiple deep-seated landslides and simultaneous multiple surface slope failures; large-scale complex disasters, such as combined sediment and flood damage, as well as serious sediment disasters in the Tohoku and Hokkaido regions where in the past there were few sediment disasters and catastrophic landslides on relatively gentle slopes, due to changes in the locations where heavy rains fall; changes in tropical cyclone intensity and tracks; increases in insurance payments from natural disasters; and reductions in the maximum number of years of fire insurance contracts due to the findings of climate change research. In addition, the use of event attribution and other methodologies is further clarifying the contribution of climate change to disasters, such as river and inland flooding.

(2) Projected impacts

Projected impacts include increased heavy rain events that can cause floods, increased flood peak flow and the probability of floods occurring, increased cost of damage; increased population likely to be affected by inundation due to inland flooding; increased expected costs of damage from inland flooding; a rising sea level trend and associated impacts on water intake facilities on rivers and coastal disaster prevention facilities, as well as port and fishing port facilities etc.; increased storm surge anomalies due to changes in scales and tracks of named tropical cyclones and increased risk of high waves; the disappearance of sandy beaches due to sea-level rise; increased frequency of combined sediment and flood damage and increased damage from driftwood due to severe rainfall conditions; and increased strong winds and intense tropical cyclones and increased frequency of strong tornadoes. There are also concerns about the impact of increased frequency of combined sediment and flood damage and increased damage from driftwood under severe rainfall conditions, as well as the impact of the increased frequency of strong tornadoes.

■ Basic approach to adaptation measures

(a) Floods and inland waters

- Projections of future climate change suggest increases in the frequency and strength of heavy rain, increases in total precipitation, mean sea level rise, and increases in extremes of storm surges and high waves. In addition to the intensification and frequent occurrence of water disasters, there is concern about the occurrence of large-scale disasters in new forms due to complex factors, such as combined sediment and river flooding, combined storm surges, and river flooding. Despite ranges in climate change projections concerning river infrastructure improvement and town (city) development that require a long time to implement, if measures are not started by assessing future climate change etc., the period required for necessary river infrastructure improvement may be prolonged because of reassessing the plan and implementation of additional measures. Therefore, prompt changes of plans to those established in consideration of climate change are urgent tasks.
- Review the plans that were established in consideration of climate change related to water disasters that are occurring more frequently and becoming more severe due to

climate change; promote "River Basin Disaster Resilience and Sustainability by All" conducted in the entire river basin in cooperation among the national government, prefectural governments, municipal governments, local companies, residents, and every stakeholder; and implement comprehensive DRR measures that integrate structural and nonstructural measures.

- In addition, concerning water disasters, which became more severe and more frequent due to climate change, when considering the speed of development against increases in external forces, it is not easy to increase flood control safety levels based on the plan only by means of conventional infrastructure development focused on river areas under the leadership of managers. For this reason, implement "River Basin Disaster Resilience and Sustainability by All" efforts that mitigate damage to the entire river basin, including catchment areas, rivers, and flood areas, and that is participated in by all people in the river basin, including people related to the river basin who have not previously been involved so that the water flow where rainfall flows into a river and the river floods can be considered as a system while implementing existing preliminary DRR measures under the leadership of managers.
- Concerning "River Basin Disaster Resilience and Sustainability by All," the following three elements should be implemented in a comprehensive and multilayered manner based on river basin characteristics, keeping in mind the occurrence of any type of flood up to an assumed maximum size flood, and including the participation of all people in the river basin:
    - Measures to prevent and mitigate flooding as much as possible (response to hazard)
      Implement development etc. of flood control facilities so that flooding can be prevented as much as possible.
    - Measures to reduce the targets of damage (response to exposure)
      Measures to reduce the targets of damage, such as town (city) development, including restrictions on land use and devising ways of living to avoid damage, with the idea of not living on dangerous land on the assumption of cases where massive flooding that exceeds the capacity of flood control facilities occur.
    - Measures to mitigate damage for early recovery and reconstruction (response to vulnerability)
      In response to the occurrence of floods, implement measures to mitigate damage, for example, by enhancing the system so that people can evacuate accurately and appropriately, and implement measures for early recovery and reconstruction in affected areas.
- Concerning increases in rainfall amounts and rising tide levels etc. due to climate change, implement the following measures that integrate structural and nonstructural measures in cooperation among relevant ministries and agencies, relevant local governments, and between the public and private sectors, in addition to flood control measures under the leadership of managers:
    - Strengthen the flood control function of existing dams and agricultural reservoirs, including water utilization dams.
    - Use the rainwater storage and infiltration function of paddy fields, agricultural reservoirs, etc.
    - Eliminate areas where there is no information related to water disaster risks.
    - In cooperation with departments in charge of urban planning, construction, etc.,

impose restrictions on land use in cooperation among multiple local governments, introduce residence guidance, devise ways of living, and propose other forms of town (city) development for DRR.

- Enhancement of first-aid activities and preparation for business continuity etc.

- In addition, when promoting "River Basin Disaster Resilience and Sustainability by All," promote the use of green infrastructure using the diverse functions of the natural environment, secure and increase rainwater storage and infiltration functions by control basin, etc., and proactively conserve or reproduce ecosystem functions that contribute to mitigating the risks of disaster and thereby create an ecological network.
- In order to respond to water disasters that are becoming more severe and frequent, it is also important to strengthen nonstructural measures, such as strengthening weather observation systems against concentrated heavy rains and tropical cyclones, and increasing prediction accuracy. Encourage resident evacuation behavior by technical improvements in the announcement of heavy rain emergency warnings, risk distribution to show the risk of disaster occurrence (Kikikuru), and other initiatives, strengthen and promote further activities for their appropriate use during ordinary times as well, and thereby reduce the number of casualties by weather-related disasters etc.
- In addition, in order to ensure the continued observation system of meteorological satellites to ensure people's safety and security, such as monitoring and predicting tropical cyclones and intense heavy rainfall, ensuring the safe navigation of aircraft and vessels, monitoring the global environment, and volcanic monitoring, the start of manufacturing of successor satellites in and around FY 2023 with the start of operation in and around FY 2029. Incorporate high-density observation and the latest technologies into the successor satellite to mitigate damage from natural disasters through advanced disaster prevention and weather information.
- When promoting these measures, it is important to avoid exposure by reading the local geography and ecosystems and adopting the concepts of ecosystem-based disaster risk reduction (Eco-DRR), where vulnerability is reduced using the functions of healthy ecosystems and green infrastructure.

(b) High waves and storm surges

1) Harbors and fishing ports

- Because of the characteristics of harbors and fishing ports that exist at the water level, adaptation to climate change must occur in the future. Therefore, it is appropriate to consider that the new facilities to be developed and existing facilities that are assumed to be used in combination for a long period are highly likely to suffer impacts during the period of combined use.
- Based on the *Disaster Risk Reduction Measures by Integrating Tangible and Intangible Measures in Future Harbors and Fishing Ports* (August 2020, Council for Transport Policy Report) and while considering socioeconomic activities and land use in areas on both the waterside and the landside, endeavor to control increases in risks from storm surges and other events in waterside and landside areas and maintain port and harbor activities by strategically and adaptively promoting the optimal combinations of tangible and intangible adaptation measures depending on the priority of risks to be mitigated. In addition, incorporate climate change adaptation measures into various types of programs and plans and promote the implementation of adaptation measures effectively through collaboration with a variety of other policies and efforts (mainstreaming of adaptation

measures).

2) Coastlines
- Accurately identify signs of the impact of climate change through marine monitoring, consider the medium- and long-term trends in socioeconomic activities and land use in the land-side areas, change from the single line of defense by breakwaters and seawalls to multiple lines of defense for tsunami protection by using all tangible and intangible measures, and implement measures with the optimal combination strategically and adaptively, and thereby control increases in disaster risks from storm surges and other events and conserve national land at coastlines.
- In addition, as to external forces that have increased because of climate change, concerning the design high-water level, a rise in mean sea level and increases in the amount of sea-level anomalies have been predicted, and concerning design waves, increases in the power of ocean waves, and other matters are predicted. For this reason, it is necessary to review these external forces that are the target of coastal conservation from those based on past sea levels and other results to those in consideration of sea levels based on future projections.
- Implement "River Basin Disaster Resilience and Sustainability by All" efforts where damage is mitigated for the entire river basin, including catchment areas, rivers, and flood areas and with the participation of all people in the river basin, including people related to the river basin who have not been involved before. In addition, at the river mouth, adjustment and consideration are necessary to continue the protection functions between rivers and coastlines, such as connecting river dikes and sea dikes, and setting the water levels used for river planning.

3) Fishing ports and villages
- Engage in DRR measures against disasters from tropical cyclones and low atmospheric pressure, and other events that are thought to become severe in the future and promote the creation of disaster-resilient fishery areas.
- In addition, since residential buildings are crowded in small spaces close to mountains and cliffs, and there are many vulnerable points for disasters in fishing villages, it also strengthens countermeasures against fire, mudslides, and other disasters.

4) Coastal disaster-prevention forests
- Promote the development and conservation of coastal disaster-prevention forests.

5) Airports
- The impact on airport facilities from increasing natural hazards associated with climate change, such as mean sea level rise and high waves should be studied to reflect it in DRR measures for airports.

(c) Sediment disasters (Debris flows, landslides, etc.)
- Sediment disasters occur because of the interrelation between complicated contributing factors and predispositions, and accurate forecasting is difficult. Therefore, implement structural measures and nonstructural measures and review plans of countermeasures for sediment disasters that are becoming more large-scale and occurring more frequently.
- In recent years, concerning combined sediment and flood damage, which are assumed

to occur frequently throughout Japan because of heavy rainfall in association with climate change and for which the risks are considered to increase from the simultaneous occurrence of slope failures and debris flows and increases in river discharge, establish the assessment method of sediment and flood damage, such as identifying dangerous areas for combined sediment and flood damage, and implement effective preliminary DRR measures, such as building sediment control dams and sediment-retarding basins in river basins with higher risks, and thereby promote effective development.

- Promote the effective installation of facilities for a large amount of driftwood that occurs and flows down with combined sediment and flood damage, debris flows, and other events.
- There is concern that sediment movement will occur more frequently because of the changes in rainfall characteristics in association with climate change, and it may become necessary to examine and review the timing and frequency of maintenance and management of sediment control dams etc., in addition to steadily implementing preliminary DRR, such as the installation of sediment control dams. Therefore, maintenance and management plans need to be considered.
- Concerning sediment disasters that will occur more frequently and become more severe, focus on the implementation of sediment disaster countermeasures to maintain lifelines, important traffic networks, local government offices, etc., and promote countermeasures against combined sediment and flood damage that will occur more frequently because of climate change, disseminate risk information using sediment disaster hazard maps based on the Act on Sediment Disaster Countermeasures for Sediment Disaster Prone Areas, and thereby promote structural and nonstructural countermeasures.
- Newly establish an assessment method to appropriately assess where and how sediment movement phenomena will occur more frequently than before or will newly occur because of changes in rainfall characteristics in association with climate change. In addition, make assessment results available so that they are recognized by society.
- Concerning "River Basin Disaster Resilience and Sustainability by All," the following three elements will be implemented in a comprehensive and multi-layered manner:
  - Measures to prevent and mitigate flooding as much as possible (response to hazard)
    Implement installation of flood and sediment control facilities so that damage can be prevented as much as possible.
  - Measures to reduce the targets of damage (response to exposure)
    Measures to reduce the targets of damage, such as town (city) development, including restrictions on land use and devising ways of living to avoid damage with the idea of not living on dangerous land, on the assumption of cases where massive flooding that exceeds the capacity of flood and sediment control facilities will occur.
  - Measures to mitigate damage for early recovery and reconstruction (response to vulnerability)
    In response to the occurrence of floods and sediment disasters, implement measures to mitigate damage, for example, by enhancing the system so that people can evacuate accurately and appropriately, and implement measures for early recovery and reconstruction in affected areas.
- The impact on airport facilities from climate change-induced increases in the frequency and intensity of heavy rainfall should be studied to reflect it in DRR measures for airports.

(d) Mountainous disaster and forest conservation works and forest road facilities (Debris

flows, landslides, etc.)

- In light of the increasing and intensifying tendency of mountainous disasters resulting from the increasing frequency of heavy rain and heavy snowfall etc., promote forest conservation measures and forest management based on the Five-Year Acceleration Plan for Disaster Prevention, Disaster Mitigation, and Building National Resilience and other measures.
- In order to enhance preparedness for increases in water disaster risks due to climate change, promote the management and conservation of headwater forests in all river basins in collaboration with the "River Basin Disaster Resilience and Sustainability by All" efforts.
- Promote forest conservation measures that aim to build resilience against swollen sediment overflow triggered by the mass collapse of hillsides from the ridge line, more severe driftwood disasters, river flooding in wider areas, and other changes in the mode of occurrence of disasters.
- Promote preventive measures for mountainous disasters in a way that integrates erosion control in forests and information-based countermeasures and undertake research and studies on the impact on the forests and forestry industry in order to better respond to the increasing frequency of torrential rainfall in association with climate change.
- In order to respond to intensifying disasters, to accommodate larger vehicles, and to streamline the collection and transportation of logging residues, build more resilient and durable road networks by designing routes that go along the ridge lines and bypass areas along rivers, securing enough margins in the width of the road and curving lines, establishing lumberyards, and other spaces, and enhancing drainage functions.

(e) Promotion of adaptive recovery

- When recovering from a disaster, we must not be confined to simply restoring the affected area to the way it was before the disaster struck; rather, taking into consideration the perspective of controlling future maintenance costs for infrastructure, it is necessary to promote the idea of"Adaptive Recovery" that considers adaptation to climate change, including control of land use and moving residential buildings and facilities to places with lower disaster risks.

(f) Other common activities

1) Enhancement of preparations for the management of disaster waste etc.
   - Promote the formulation of contingency plans for waste management and engage in activities to build a resilient waste management system.
2) Investigations and research, and technology development
   - Based on the projection of increases in external forces, promote the technology development of dikes etc. in consideration of the impact on facilities, development of quantitative assessment methods of disaster mitigation functions by blue carbon ecosystems, etc., and other investigations and research.

5.5.5 Human health

■ Overview of climate change impacts

(1) Current status

It has been reported that excess mortality due to heat stress is on the rise, especially among

the elderly. Regarding heat illness, the numbers of patients transported by ambulance, medical consultations, and mortalities related to heat illness are all on the rise, although the numbers vary from year to year. In 2018, the number of patients with heat illness transported by ambulance exceeded 95,000, a record high since studies began. There were more than 1,500 deaths due to heat illness that year, more than 80% of them being elderly people. The impact of the worsening of the heat stress environment on the elderly is significant, and the risk of heat illness for the young is increasing. The effects of extreme heat also have health impacts, such as sleep quality deterioration, fatigue and tiredness, exhaustion, and other signs of physical function deterioration, as well as mental and physical stress. In addition, there have been new reports that changes in outdoor air temperatures can change the risks and pattern of outbreaks of water-borne and food-borne infectious diseases, such as infectious gastrointestinal disease, rotavirus, and diarrhea, and other infectious diseases, such as influenza and hand, foot, and mouth disease. As for vector-borne infectious diseases, there are concerns that increased temperatures will change the distribution, population density, and active period of arthropods, and combined with the movement of infected people within the country, will cause a chain of infections.

(2) Projected impacts

Heat stress is expected to increase because of the increase in temperature, and the risk of heat illness is expected to increase, especially for the elderly. With regard to water-borne and food-borne infectious diseases, the morbidity of diarrhea is expected to decrease, particularly in winter throughout Japan, toward the end of the 21st century as the temperature increases. It has been indicated that the Asian tiger mosquito (hitosujishimaka, or *Aedes albopictus, subgenus Stegomyia*) may expand as far as north as southern Hokkaido, where it has not yet reached or become established, and the distribution of alien mosquitoes that transmit the Japanese encephalitis virus may expand north of Kagoshima Prefecture. In addition, tick species that prefer warmer regions have been reported in the Tohoku region, and ticks brought in from overseas may also become established in Japan. In the short term to the 2030s, the number of excess mortalities due to increases in pollutants, such as photochemical oxidants and ozone, are projected to increase as a result of warmer temperatures but decrease thereafter.

■ Basic approach to adaptation measures

(a) Heat stress (Mortality risk and heat illness)

- The nationwide increasing trend in the number of patients transported by ambulance, the number of patients that visited medical institutions, and fatalities due to heat illness have been confirmed, and increases in heat illness risks are projected; it is, therefore, necessary to provide reminders on heat illness and to disseminate them to relevant organizations etc. When transmitting information, it is effective to implement measures in combination with raising awareness of the measures to be taken by individuals.
- In particular, based on the fact that there are many elderly people with heat illness transported by ambulance and fatalities due to heat illness and that increases in the number of fatalities of elderly people due to heat stress and in the occurrence rate of heat illness are projected, it is important to disseminate information related to heat illness prevention to aging households. Measures targeting elderly people are important, but attention must be paid not to omit other targets who need measures, including those

working outside and playing sports.

- In addition, it has been reported that there are many cases where heat illness occurs while working outside. Therefore, when working under severe conditions, such as under the searing sun, it is important to reduce the intensity of physical labor by mechanization etc., shorten continuous working hours, change working hours, and implement other preventive measures against heat illness. It is also necessary to consider technology development and the improvement of machines contributing to making work lighter.
- It is also important to collect and assess information related to results etc. from the actual introduction of adaptation measures continuously and to collect information on advanced cases.
- In order to handle the aforementioned issues, the government revised and upgraded the Liaison Conference of Ministries and Agencies Concerned with Heat Illness to the Heat Illness Prevention Conference in March 2021 for the further promotion of heat stroke measures. The Heat Illness Prevention Conference established a Heat Illness Action Plan and determined that the national government, local governments, industry, various organizations, and people should implement heat illness measures together.

5.5.6 Life of citizenry and urban life

■ Overview of climate change impacts

(1) Current status

In recent years, the impact of such events as heavy rains, tropical cyclones, and droughts on infrastructure and critical services has been increasingly evident in many places in Japan. Besides causing direct damage to facilities for power generation, water purification, and waste treatment, these weather events also caused major disruptions to the lives of citizens by disrupting critical services, such as electricity, gas, and water, and isolating communities due to disruption of a transportation network.

Changes have been confirmed in the phenology of flora and fauna that have been experienced in the lives of the people, such as cherry blossoms, ginkgo trees, cicadas, and wild birds; in terms of local industries, there have been reports of deterioration in the quality of sake rice varieties due to warmer temperatures, as well as expanded production areas for wine-making grape varieties in Hokkaido. In urban areas, the combined impacts of temperature rise because of climate change and the heat island effect are increasing heat stress and the risks of heat illnesses and affecting the quality of life by causing fever, nausea, weakness, and deterioration in the quality of sleep.

(2) Projected impacts

There are concerns that future extreme weather events will have impacts on a variety of infrastructure and critical services of electricity, water supply, transportation, communications, and waste treatment. In terms of phenology, the season of the cherry blossom flowering and full bloom is expected to change because of the increase in temperatures, and that will have an impact on areas that rely on this season as a tourism resource.

The combined effects of climate change and the heat island effect are likely to keep temperatures increasing in urban areas, leading to concerns that the deterioration of the thermal environment in cities may have major impacts on urban life.

■ **Basic approach to adaptation measures**

(a) Water supply, transportation, etc.

- In order to respond to the impact of heavy rains, tropical cyclones, drought, etc. on the various infrastructures and lifelines, engage in making facilities and systems more resilient, disseminate the concept of green infrastructure and promote the implementation of the concept in society.
- It is necessary to implement multiple measures based on the surrounding environment (building up the electricity storage system and emergency water supply system) and to examine ideal infrastructures and lifelines based on sea-level rises in urban waterfront areas.

(b) Impacts on life due to heat stress

- In order to mitigate heat island effects, continue to implement feasible measures, including the securing of green spaces and greening in urban areas, along with measures that can show effects over a short period of time, such as intangible measures.
- Based on the fact that the mitigation of heat island effects requires a long period of time, monitor the actual status of heat island effects and engage in technical investigation and research of heat island measures.

5.6 Adaptation efforts by local governments and business operators

5.6.1 Efforts by local governments

Under the *Adaptation Act*, it is stipulated that local governments strive to promote measures related to climate change adaptation based on natural, economic, and social circumstances in the local areas and strive to provide information related to adaptation measures while taking other measures in order to promote the climate change adaptation of business operators and others and business activities contributing to climate change adaptation in the local areas.

In addition, under the *National Climate Change Adaptation Plan*, the basic role of local governments is defined as promoting climate change adaptation based on local natural, economic, and social circumstances, the local promotion of climate change adaptation with stakeholders, and the local enhancement and use of scientific findings. As stated below, there are relevant provisions in the section on basic measures.

As of March 2022, 155 local governments (including 46 prefectures, 18 ordinance-designated municipalities, and 91 municipalities) have formulated *Local Climate Change Adaptation Plans* and are implementing adaptation measures based on local circumstances in a planned manner.

In addition, as of March 2022, 47 local governments (including 37 prefectures, 3 ordinance designated municipalities, and 7 municipalities) established Local Climate Change Adaptation Centers that serve as bases to collect, organize, analyze, and provide information related to local climate change impacts and climate change adaptation and to provide technical advice.

In order to further strengthen the collaboration among stakeholders in the local areas and to

promote climate change adaptation in collaboration among wide-ranging stakeholders at the local level, based on the provisions of the *Adaptation Act*, the Regional Councils on Climate Change Adaptation in which regional environment offices and other local administrative organs of the national government, prefectural governments, municipal governments, Local Climate Change Adaptation Centers, business operators, and other entities participated were established in seven regions in Japan.

The National Research and Development Agency National Institute for Environmental Studies manages and operates the Climate Change Adaptation Information Platform (A-PLAT) to consolidate and provide climate change risk information etc. to local governments etc. based on the provisions of the *Adaptation Act*. It establishes *local climate change adaptation plans* and provides technical support to Local Climate Change Adaptation Centers.

The national government implemented the "Regional Adaptation Consortium Project" as a collaboration project between the Ministry of the Environment, Ministry of Agriculture, Forestry and Fisheries, and Ministry of Land, Infrastructure, Transport and Tourism for three years from the fiscal year 2017; collected and organized information related to climate change impacts based on the needs of each region; built a collaboration system between local governments, universities, research institutions, and other local relevant people; and examined concrete adaptation measures. Furthermore, from the fiscal year 2020, the national government established subcommittees (two to three subcommittees/block) in the Regional Councils on Climate Change Adaptation and is implementing the Wide-range Action Plan Establishment Project for Climate Change Adaptation to examine issues requiring collaboration among stakeholders, such as adaptation issues beyond prefectural borders and other common issues.

5.6.2 Activities by business operators

Under the *Adaptation Act*, it is stipulated for business operators to engage in climate change adaptation based on the details of their business activities in order to implement their business activities smoothly and to strive to cooperate with the measures of the national government and local governments related to climate change adaptation.

In addition, under the *National Climate Change Adaptation Plan*, as the basic roles of business operators, the promotion of climate change adaptation based on the characteristics of business details and the development of adaptation businesses are defined. Furthermore, it developed basic measures for adaptation related to industrial and economic activities and has relevant provisions in the section on basic measures.

In the *Assessment Report on Climate Change Impacts in Japan* that was published in December 2020, concerning industrial and economic activities, 11 subitems (manufacture, food manufacture, energy, commerce, retail, finance/insurance, tourism, leisure industry using natural resources, construction, medical, and others) were assessed. The outline is as stated in the following table.

Table 5-2 Outline of the Assessment Report on Climate Change Impacts in Japan (industrial and economic activities)

Industrial and economic activities
(Manufacture) - Stopping operation plants, etc. due to heavy rainfall, tropical cyclones, etc.* **(Energy)** - Changes in energy demand in association with increased air temperature** - Changes in power generation of recyclable energy (hydroelectric power plants, etc.)** **(Commerce)** - Temporary closure of department stores, supermarkets, etc. due to heavy rainfall, tropical cyclones, etc.** - Growing difficulty in predicting demand for seasonal goods (beverages, clothing, etc.)** **(Finance/insurance)** - Increases in insurance payments due to large-scale natural disasters** - Increases in demand for insurance, increases in business opportunities, such as the development of new goods** **(Tourism)** - Loss or decreases in leisure sites and resources using natural resources (forests, snowy mountains, sandy beaches, tidal flats, etc.)*** **(Construction)** - Revision of design conditions, standards, etc. related to wind load, air-conditioning load, etc.* **(Medicine)** - Increases in damage from inundation of medical institutions due to flooding* **(Other (overseas impacts, etc.))** - Impacts on the economy in Japan through the global supply chain* - Impacts of climate change on national security -

Underlined: Newly added impacts in this climate change impacts assessment. Asterisks and codes at the end of each sentence indicate the assessment results related to confidence for the corresponding sub-items and detailed items.

***: High confidence **: Medium confidence *: Low confidence -: Cannot be assessed at current status.

There are no subitems where significance, urgency, and confidence are all high; however, in many industries, climate change impacts are predicted, and the necessity of preparing for these impacts and engagement in climate risk management are increasing.

Concerning climate risk management, the Ministry of the Environment revised the *Climate Change Adaptation Guide for Private Sector -Preparing for Climate Risk and Surviving* in March 2022, established in March 2019, and enhanced the description of the latest climate risk information and the concepts and methods to address adaptation measures. In addition, in September 2021, the relevant ministries and agencies established the Public-Private-Academic Networking Meeting on Climate-related Risks in Japan with the aim of improving issues in promoting climate change adaptation through the regular exchange of views and collaboration among industry, government, and academia. In addition to supporting the efforts of businesses through these initiatives, the National Research and Development Agency National Institute for

Environmental Studies compiled cases in construction, manufacture, wholesaling, retailing, etc., on the Climate Change Adaptation Information Platform (A-PLAT) that it manages and operates.

At the same time, concerning activities for adaptation businesses, the Ministry of Economy, Trade and Industry investigated the information disclosed by Japanese companies and analyzed activities that are analogized to contributing to overseas adaptation measures. As a result, seven major fields were indicated where Japanese companies could contribute internationally to adaptation businesses: Resilient Infrastructure against Natural Disasters; Sustainable Energy Supply; Food Security, Agriculture/Strengthening Food Production Base; Health and Sanitation; Weather Observation, Monitoring, and Early Warning; Securing Resources/Stable Water Supply; and Finance Related to Climate Change Risks. The Ministry of Economy, Trade and Industry created the Climate Change Adaptation Good Practices by the Japanese Private Sector (March 2021) based on these fields, introduced adaptation business cases of Japanese companies at seminars inside and outside Japan, and thereby supports adaptation business activities. In addition, the Climate Change Adaptation Information Platform (A-PLAT) compiled adaptation business cases in each sector, including agriculture, forestry and fisheries, water environment and water resources, natural ecosystems, natural disasters and coastal areas, human health, industrial and economic activities, and life of the citizenry and urban life, and adaptation business activities in and outside Japan are gradually being activated.

In addition, relevant ministries and agencies, local governments, research institutions, universities, private sectors, etc. are holding symposiums and seminars, creating and publishing guidebooks, etc., and business operators are promoting climate change adaptation based on business characteristics by business operators and supporting the development of adaptation business.

Towards acceleration of activities for climate risk management and adaptation business, behavioral changes are encouraged, and the need to expand adaptation financing is becoming recognized from the perspective of promoting the transfer and dispersion of increasing risks. Under these circumstances, the movement to encourage activities of financial institutions has started, such as the Ministry of the Environment published *Guide for Adaptation Finance* (March 2021).

Furthermore, in response to the proposal of the Task Force on Climate-related Financial Disclosures (TCFD) of the Financial Stability Board (FSB) that was published in June 2017, the number of companies that disclosed information related to climate change impacts (physical risks and opportunities) in their annual reports and sustainability reports is increasing. TCFD publishes institutions that have the intention of proactively disclosing financial information related to climate change. A total of 3,640 companies and institutions, including financial institutions, agreed with the intent globally, and Japan has the largest number of supporting companies and institutions, at 1,010 (as of July 25, 2022; confirmed with https://tcfd-consortium.jp/en/about on August 3, 2022).

5.7 Cross-sectoral efforts and international cooperation

5.7.1 Cross-sectoral efforts

In terms of cross-sectoral efforts, the *National Climate Change Adaptation Plan* stipulates the following as basic measures related to climate change adaptation.

- **Basic measures for the enhancement and utilization of scientific knowledge on climate change and other related issues,**
  - The government promotes observation, monitoring, prediction, assessment, and development of historical datasets related to climate change and climate change impacts in various sectors and their investigation and research. In particular, there is a lack of monitoring data in the Arctic. To improve the precision of climate change predictions, the government will enhance monitoring data by operations of the Arctic research vessel.
  - The government promotes DRR, water resource management, farming support, biodiversity conservation, and other technical developments related to climate change adaptation, and it promotes the proactive use of technologies related to climate change adaptation.
  - In addition, in order to ensure continuous meteorological satellite observation systems for the purpose of monitoring tropical cyclones, heavy rainfall, and other global environmental issues, the government will start the operation of a successor satellite that has high-density observation and other cutting-edge technologies in FY 2029.

- **Basic measures related to ensuring the system for collection, organization, analysis, and provision of information related to climate change, etc.**
  - The government consolidates the research results, data, information, etc. of various research and study institutions etc. and thereby enhances and strengthens A-PLAT and the Data Integration and Analysis System (DIAS). In addition, in collaboration with the National Institute for Environmental Studies, the government consolidates and shares data related to climate change etc. and information on activities related to climate change adaptation that is possessed by relevant ministries and agencies, local governments, business operators, private organizations, citizens, etc.

- **Basic measures related to the promotion of measures related to climate change adaptation with local governments**
  - The government ensures a system to collect, organize, analyze, and provide information related to climate change etc., develops a manual with which local governments can establish plans related to climate change adaptation smoothly, and thereby supports the establishment and implementation of climate change adaptation plans in local governments.
  - The government encourages local governments to raise the funds required to implement the measures with a green bond, which is issued with clarifying positive environmental impacts.

- **Basic measures related to the promotion of climate change adaptation by business operators, etc., and business activities contributing to climate change adaptation**
  - The government promotes public relations activities, awareness-raising activities, and other activities to deepen the interests and understanding of citizens and business operators as to

the importance of climate change adaptation.
- The government establishes guidance to promote the voluntary climate change adaptation of business operators while referring to preceding cases overseas so that business operators can accurately promote climate change adaptation.

■ **Basic measures for securing international collaboration and promoting international cooperation related to climate change etc.**
- The government prepares an international sharing system of climate change information.

5.7.2 International cooperation

Concerning international cooperation, the *National Climate Change Adaptation Plan* positions the contribution to increasing the adaptive capacity of developing countries as one of its basic strategies and lists the following strategies.

Many developing countries generally lack the capacity to adapt to the impact of climate change. Vulnerability to current and future climate change is significant, and the impact of climate change may become more severe. From the perspective of ensuring safety, actions on the impact of climate change in developing countries are important.

For this reason, the national government uses the Asia-Pacific Climate Change Adaptation Information Platform (AP-PLAT), which was established to support decision-making in consideration of climate change risks and highly effective climate change adaptation in the Asia-Pacific region, and promotes the enhancement of scientific findings related to climate change risks, the provision of stakeholders' support tools, development of capacities related to the assessment of climate change impacts and climate change adaptations, and other efforts in cooperation with countries and relevant institutions etc. in the region.

In addition, various international cooperation frameworks, meteorological satellites, etc. are used to promote technical cooperation (*) in the observation, monitoring, projection, and assessment of climate change and its impacts, as well as DRR, climate change adaptation of agriculture, among others.

> * Among the preceding efforts, for example, the Ministry of the Environment supported the Independent State of Samoa and the Federated States of Micronesia in developing climate risk information on storm surges and high tides, which may affect their airports. Such information is expected to be used by those countries to formulate disaster prevention plans and maintenance plans for their airports. In addition, in Indonesia and Vietnam, the Ministry of the Environment supported the risk assessment of the impact of climate change on the production of paddy field rice, which is their staple diet, which resulted in the formulation of adaptation plans in each country.

Based on regional circumstances, in order to establish projects to respond to future climate change impacts systematically, promote using local universities etc. so that the results of their research and technology development can be used.

In addition, the national government uses AP-PLAT and DIAS etc. to promote the international development of Japanese adaptation businesses. Furthermore, Japan utilizes the observation, monitoring, projection, and assessment of climate change and its impacts, disaster prevention experiences in Japan, technologies related to disaster prevention, climate change adaptation of

agriculture, etc., and other knowledge to promote overseas development and international cooperation by the government and private sectors.

5.8 Other basic measures related to promoting adaptation measures

In 2020, a new crisis, COVID-19, emerged in addition to climate change. They are deeply connected to each other. Social changes to improve the environment, economy, and society integrally, the conservation of biodiversity, and the coexistence with nature are essential to overcoming the crisis. For this reason, it is important to direct environmental policy in Japan through three transitions: the transition to a decarbonized society, the transition to a circular economy, and the transition to a decentralized society in harmony with nature, and then for local governments to develop regions newly based on the concept of a Circular and Ecological Economy, and for citizens to redesign society into one where each person changes their lifestyle. Based on these concepts, Japan is taking on various efforts.

The aforementioned Circular and Ecological Economy is a concept of an "independent and decentralized society" where we use local resources in our area and incorporate them into the structure of society in the form of businesses and projects to improve the environment, economy, and society, and to create support networks between local areas by using regional characteristics, such as urban areas and farm villages. The concept was proposed in the Fifth Basic Environment Plan, which was approved by the Cabinet in 2018. The Circular and Ecological Economy is a concept aiming to resolve various local issues integrally from the perspective of the environment and to be achieved through partnerships. It is also an effort to implement local SDGs.