

Promotion Strategy of the Environment Field (unofficial version)

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1. Current Status of the Environment Field

(1) Current research status

The environmental focus has shifted from individual pollution issues to those requiring a domestic and international socio-economic approach toward achieving a “sustainable society” with little environmental load. Consequently, R&D in the environment field needs to develop into comprehensive research that grasps the overall picture, ranging from individual process studies, to analyzing phenomena, evaluating the impact, developing counter technologies and assessing applicability to society. Future R&D tasks also include integrating social, human and natural sciences, and developing a research structure that facilitates visionary and preventive projects.

(2) R&D issues requiring improvement

The following are some of the main R&D issues that need improvement in the environment field:

- (a) The government is not setting out its overall R&D approach, leaving individual ministries to conduct R&D separately. Focal R&D themes must be pursued through initiatives under a more integrated research mechanism, organized across ministerial borders.**
- (b) There have been insufficient efforts to promote fundamental research (e.g., long-term continuous environmental observation) and improve intellectual research infrastructures. Systematic and continuous R&D investments are needed.**
- (c) Environmental research in human and social science areas is insufficient (including environmental policy studies, environmental economics, ecological ethics, etc.). It is necessary to enhance R&D in these areas, and strengthen their coordination with environmental studies in the area of natural science.**
- (d) There is a lack of timely supply in human resources for addressing various environmental research issues. It is necessary to boost specialized environmental education at postgraduate schools, etc., while promoting freer flow of human resources.**
- (e) The government is not actively participating in international**

environmental research initiatives. It is necessary to foster human resources that can lead research in the international arena.

2. Areas of Focus

(1) Priority approach

In prioritizing specific fields or tasks we must take the following points into account, based on the perspective of international contribution.

- (a) Contributing to the resolution of urgent and significant environmental issues.**
- (b) Assisting the development of a society that enables sustainable development.**
- (c) Delivering a significant impact in improving the quality of living and in revitalizing the industry and economy.**

Based on these perspectives, areas of focus have been defined as “R&D for resolving global environmental issues”, “R&D for comprehensive management of chemical substances”, “R&D for developing a recycling-based society” that are described in the second term basic plan, and “R&D for developing a eco-harmonic society”.

(2) Promoting R&D in tri-sector partnership

Since environmental issues involve complex and diverse association of phenomena, conducting research into individual aspects does not lead to effective resolutions. Recent environmental issues, in particular, are affecting greater areas and are worsening, raising the need to take a comprehensive new R&D mechanism beyond the conventional framework. In order to address areas of focus, individual research, conducted by separate ministries, should be brought together, reorganized in coherence, and promoted under government initiative with scenarios defining policy goals and a process for resolution.

(3) Priority tasks

Based on the propriety of the approach described above, priority has been given to five tasks. Of those, top priority is given in FY 2002 to R&D for global warming, R&D for waste-free / resource recycling technologies, and R&D for eco-harmonic regeneration of river basin and urban areas.

- (a) R&D for global warming**
 - i. Objective**

To conduct observations and predictions on global warming, assess the effects of environmental fluctuations (temperatures, sea level, etc.) on nature, the economy and society, and develop technologies for averting or minimizing their adverse effects.

ii. Necessity for urgent prioritization

In the issue of global warming, there is a need for continuously implementing fundamental efforts domestically and internationally toward the objective set out in the UNFCCC (United Nations Framework Convention on Climate Change). Japan has a significant mission and responsibility in contributing to international frameworks such as IPCC (Intergovernmental Panel on Climate Change), which reviews the progress of the Kyoto Protocol that was adopted in COP3 (Third Conference of the Parties to the UNFCCC) in 1997, as well as cutting-edge scientific findings on global warming. This issue, therefore, has a high level of necessity and urgency compared to other issues concerning the global environment. We are also expected to contribute to IPCC in its preparatory work, commencing in 2002, to compile the Fourth Assessment Report (2006 onward) covering the issues on the stabilization level of greenhouse gases.

The cause and effect of global warming are profoundly intertwined with social and economic structures, and thus require a comprehensive approach covering a broad range of areas. The government must take the initiative in addressing issues of such significance. Japan, with energy-originated CO₂ accounting for about 80% of the nation's greenhouse gas emission, needs to develop and implement energy technologies as part of its R&D policy on countermeasures for global warming. At the same time, global warming and climate change, their effects and countermeasures, are factors mutually affecting each other, and consequently research on those must be coordinated and implemented in a structured fashion.

iii. Research promotion and themes

The government initiative will include: (i) Comprehensive monitoring program for global warming, (ii) Research program for predicting global warming and climate change, (iii) Research program for assessing impacts and risks of global warming, (iv)

Program for developing technologies to fix and sequester greenhouse gases, (v) Technological development program for controlling emission of greenhouse gases caused by human activities, such as energy generation (individual technologies in this program are also defined in the energy field) and (vi) Policy research program to control global warming. Individual projects of government ministries will be integrated under each of these programs, and promoted under industry-academia-government collaboration.

Program (i) will focus on enhancing the observation and monitoring system and its database, while Program (ii) will aim at achieving advanced climate change models based on individual process studies. Program (iii) will identify and predict the comprehensive effects of global warming, as well as developing application technology for averting or minimizing its adverse effects. Program (iv) will concentrate on developing technology for absorbing, separating, recovering and sequestering greenhouse gases, whereas Program (v) will work toward energy saving and new energy technology to reduce greenhouse gas emissions. Program (vi) will focus on assessing technologies used in countermeasures, compiling future scenarios in greenhouse gas emission, and exploring policies on how to best combine mitigation and adaptation measures.

(b) R&D of waste-free, resource recycling technologies

i. Objective

To develop technologies and systems for a material-recycling society with a low environmental load for controlling resource consumption and waste generation, and for minimizing the environmental load.

ii. Necessity for urgent prioritization

In order to ensure sustainable development of Japan's economy and society, we must implement the concept of 3R (Reduce, Reuse and Recycle), dispose waste properly and utilize nature's own recycling function, and develop a recycling-oriented society in which the consumption of natural resources is controlled and the environmental load is minimized. In 3R, technological strength contributes significantly to industrial and corporate

competitiveness through cutting costs through environmental load reduction and by improving production efficiency and appropriate energy consumption. For this reason, planting new seeds of technology will not only help build a recycling-oriented society, but will also strengthen the nation's industrial competitiveness in the world economy. Transferring 3R technology to developing countries will also represent our major contribution to the world effort to develop a world-wide recycling-oriented socio-economic system.

In order to develop this recycling-based society, there should be a system in place for mutually coordinating individual technologies. Resource recycling, appropriate on an individual regional scale, should be established through increasing the applicability of recycling systems to local industrial structures and lifestyles. Since many products are now produced overseas, the efforts must go beyond national borders to coordination with overseas producers. Inappropriate and illegal waste processing and disposal continue to be reported frequently on an aggravating scale, accumulating a negative legacy such as contaminated soil and unsuitable disposal grounds. To provide a sense of safety and security, it is an urgent task to develop and utilize appropriate waste processing technologies, extend the life of processing plants and remedy the environment surrounding illegal waste dumping sites.

iii. Research promotion and themes

The government initiative will include programs for (i) developing a support system for creating a recycling-based society, (ii) recycling technologies and systems, (iii) recycling-oriented design and production and (iv) technologies and systems for appropriate waste processing and disposal. Individual projects of government ministries will be integrated under each of these programs, and promoted under industry-academia-government collaboration.

Program (i) will focus on assessment through lifecycle assessment, material and energy flow analysis, etc., on future prediction methods, on developing technology for the introduction and promotion, and on building a system for maintaining contact with

people's lives, which is where the movement toward a recycling-oriented society begins. Program (ii) covers technologies and systems for recycling automobiles, construction waste, organic waste, clothing, etc., and for promoting regional-based recycling advancement (social model verification, etc.). Program (iii) works toward developing design, construction and production technologies for reducing waste and for facilitating recycling and reuse, while Program (iv) works toward developing technologies for reducing waste and providing for its advanced recycling, introducing decomposition processing of waste containing hazardous materials, regenerating landfills, remedying contaminated environments and monitoring for inappropriate waste processing.

(c) R&D for eco-harmonic regeneration of river basin and urban areas

i. Objective

To develop technologies for observing, diagnosing and assessing urban environments and ecosystems in river basin areas, and management models for river basin areas, in order to develop eco-harmonic urban communities. In addition, to develop technologies and methods for the regeneration and renovation of urban and river basin environments.

ii. Necessity for urgent prioritization

Japanese cities have traditionally emerged and developed along rivers, founded on the natural circulation system of river water. However, the period of post-World War II economic growth led to a high concentration of population and economy in Tokyo and other coastal cities. These subsequently evolved into mega cities with increased water demand and contaminant discharge, causing significant strain on the environment of river basin communities. Consequently, the natural foundation for sustaining cities has collapsed, creating the need to preserve and remedy the environment of river basin areas as a whole. Efforts should also be made to improve the city environment, which is suffering from a high environmental load and reduced or jeopardized environmental systems, and to provide increased opportunities for people to connect with nature, thus delivering a "healthy", "safe and secure" and "comfortable" living environment in cities.

Given the present circumstances, we must recognize large cities as a component of river basin areas, and aim for shaping eco-harmonic cities, while controlling the sprawling expansion of urban areas, and establishing a structured and close relationship with other river basin areas. Water circulation, in particular, is the key factor in developing and transforming cities and ecosystems in river basin areas. Therefore, it is necessary to regenerate and renovate the natural and social environmental foundation, while defining borders systematically separating cities from surrounding communities to maximize the benefit of natural water circulation within river basin areas. To this end, we must work toward acquiring and systemizing scientific knowledge, and developing relevant technologies and systems.

Overall, it is necessary to implement and control data from continuous and comprehensive monitoring of river basin and urban environments, collect and organize related information, develop methods for comprehensive environmental management, and develop technologies for remedying jeopardized ecosystems, while designing and presenting scenarios for environmental regeneration suitable for individual cities or river basin areas, and conducting R&D toward practical regeneration and renovation technologies.

iii. Research promotion and themes

The government initiative will include programs for (i) monitoring urban and river basin environments, (ii) developing the urban/river basin management model, (iii) developing eco-harmonic technologies, and (iv) preparing and implementing scenarios to create an eco-harmonic society. Individual projects of government ministries will be integrated under each of these programs, and promoted under industry-academia-government collaboration.

Program (i) will explore technologies for observing, diagnosing and assessing river basin ecosystems and the city environment from the perspectives of natural environmental foundations (water circulation, material circulation, biodiversity, etc.) and

social environmental foundations (urban rivers, river basin areas, coast areas, etc.). Program (ii) examines the development of individual component models (e.g., water circulation model, ecosystem model) and a river basin management model integrating all component models, whereas Program (iii) focuses on water circulation and develops technologies for preserving the natural environment and for remedying deteriorated ecosystems (forests, farms, rivers, river basin areas, coast areas, etc.), as well as living space for humans. Program (iv) will concentrate on preparing a scenario for promoting the above measures, and on developing technologies for practical application.

(d) R&D for comprehensive risk management of chemical substances

i. Objective

To develop methods for comprehensively assessing and managing risks involving chemical substances, and technologies for reducing and minimizing those risks.

ii. Necessity for urgent prioritization

There is a heightening awareness, both domestically and internationally, of the risk of chemical substances. In developing a sustainable society, in which future generations can enjoy healthy living and an affluent environment with no anxiety over chemical substances, R&D on assessing and managing the risk of such substances has a significant role to play. Urgent action is especially needed against environmental endocrine disrupters with potential serious effects upon future generations, POPs now under tighter international regulations, and chemicals subject to data reporting obligations under the PRTR laws. Amidst international competition with European, U.S. and Asian countries, it will be essential for Japan to establish an innovative production technology system in harmony with the environment, in our effort to form a sustainable society.

People are exposed to chemical substances via environmental media (air, water, soil) and various other media including agricultural and fisheries produce, household appliances, tap water, and indoor air. Ministries must act in close coordination with each other in developing technologies for detecting chemicals, evaluating their toxicity and levels of exposure, making risk

assessment, and taking steps toward the risk reduction and public communication.

iii. Research promotion and themes

The government initiative will include programs for developing (i) risk assessment (ii) risk reduction technologies, (iii) risk management methods and (iv) intellectual infrastructures.

Program (i) develops innovative measuring technologies for detecting very small amounts of chemical substances, new methods in toxicity assessment, modeling technology for identifying and predicting chemical substance behavior, and risk assessment technology based on these technologies. Program (ii) focuses on establishing a production technology system in harmony with the environment, potentially minimizing by-products and waste. It also explores technologies for converting by-products into non-toxic forms, remedying and defusing contaminated soil, drainage and deposits, and reducing hazardous emissions. Program (iii) aims at systemizing knowledge for achieving an information system for chemicals control and promoting risk communication, whereas Program (iv) focuses on improving more fundamental areas such as developing and preserving standard experimental organisms and preparing a specimen banking system.

(e) R&D for global water circulation changes

i. Objective

To project the global supply and demand of water resources, project changes in water circulation and their impact from the natural and social perspectives, and to develop the optimum water management method on an international scale.

ii. Necessity for urgent prioritization

Water-related problems, such as water shortage, water contamination, and flooding, have been reported in increased numbers across the world, especially in developing countries. These factors are creating a growing impact, including food shortages and epidemic outbreaks. These phenomena are attributed to rapid population growth, urban development, and

industrial development, with water-related international conflicts already occurring in various parts of the world. With the world population set to increase, the situation is expected to deteriorate further. For this reason, the water issue is expected to become one of the biggest global environmental issues of the 21st century. With the Huang River (Yellow River) drying out before reaching the sea and the Chang River flooding, human activities are already altering water circulation systems. In affected areas (especially Asia), Japan, with its advanced economy and technology, must provide scientific expertise and the technological foundation required to enable effective and efficient water management.

This government initiative is expected to broaden Japan's technological contribution to other Asian nations, which share similar natural and social characteristics. It represents R&D for international application, with a focus on averting negative impact on Japan through resolving water problems in other countries.

iii. Research promotion and themes

The government initiative features programs for (i) observing global water circulation, (ii) developing the model of water circulation changes, (iii) assessing the impact on human society, and (iv) making a comprehensive evaluation of countermeasure scenarios and technological development. Individual projects of government ministries will be integrated under each of these programs, and promoted under industry-academia-government collaboration.

Program (i) focuses on enhancing the observation and monitoring system, and developing a database. Program (ii) is aimed at resolving the natural mechanism of change in energy transfer and water circulation, and developing a prediction model for changes in water circulation and the environment due to human activities. Program (iii) assesses the impact of water circulation changes on food production, society and the economy, whereas Program (iv) presents the optimum scenarios for countering water-related problems.

In addition to the above research tasks, the following two tasks are important in promoting environmental studies:

(f) Intellectual research infrastructure in the environment field

In order to ensure smooth environmental studies and appropriate proliferation of environmental technologies, it is important to systematically develop intellectual and research information infrastructures in environmental science and technology, including standard materials, environmental reference samples and data, biological resources, environmental monitoring, environment-related statistical data and database, methods for assessing environmental technology, and information systems for environmental research and technology.

(g) Promotion of pioneering research

Pioneering research involves discovering the fundamentals of environmental issues before they become socially manifest, and developing new research methods from unrestricted perspectives including academic areas that are not usually applied. Pioneering research should be promoted, in which emphasis must be placed on achieving a fundamental understanding and resolution of environmental issues, and exercising creativity in the process.

3. R&D Targets in Focal Areas

(1) R&D for global warming

(a) Overall target

According to the goals set out in the Framework Convention on Climate Change, the target is to acquire and systemize scientific knowledge, develop new and advanced technologies for countermeasures, and to draw up a scenario for bringing global warming under control on the basis of acquired knowledge in order to investigate the possibility of controlling greenhouse gas emission so as not to cause crisis to human beings and ecosystems.

(b) Targets of individual programs

i. Comprehensive monitoring program for global warming

To develop a monitoring system for the Asia-Pacific region to halve the uncertainty over the estimated amount of CO₂ absorbed

or released in marine and land areas, and to detect climate changes with a high degree of sensitivity. Also, establish a cooperative international network for accumulating, providing and using data.

- ii. Research program for assessing impacts and risks of global warming

To identify the mechanism of global environmental changes needed for model development and enhance the precision of models for predicting greenhouse gas concentration and climate change, so as to enhance models for future climate change prediction including tendency changes in abnormal weather conditions.

- iii. Research program for assessing impacts and risks of global warming

To make a comprehensive assessment of the impact of global warming, encompassing the entire Asia-Pacific region with a focus on Japan, clearly define future impact and risk, and devise measures for averting such risks.

- iv. Program for developing technologies to fix and sequester greenhouse gases

Toward the goals set out in the Framework Convention on Climate Change, to develop technologies for increasing CO₂ absorption into ecosystems (forests, etc.), and separating, collecting, sequestering and reusing CO₂ contained in exhaust gases, etc.

- v. Technological development program for controlling emission of greenhouse gases caused by human activities, such as energy generation

Toward the goals set out in the Framework Convention on Climate Change, to develop technologies for reducing CO₂ through energy savings and new energies, and cutting down the emission of other greenhouse gases.

- vi. Policy research program to control global warming
Present the scenario for controlling global warming, taking into consideration socio-economic trends, the uncertain nature of climate change predictions, the impact and risk of global warming, and the potential of technological innovation for mitigation.

(2) R&D of waste-free, resource-recycling technologies

(a) Overall target

To develop technologies and systems contributing to reducing waste, improving the recycling rate, and lowering environmental risks from hazardous waste.

(b) Targets of individual programs

i. Program for developing a support system for creating a recycling-based society

Based on the principles of hierarchical material circulation and low environmental load, to develop LCA methods, etc., for properly evaluating the technologies and systems needed to form a recycling-oriented society.

ii. Program for developing recycling technologies and systems
To achieve advancement and practical application in recycling technologies and systems for individual circulating resources, and to seek enhanced efficiency, advancement and application of vein logistics as the foundation for recycling systems.

iii. Program for developing recycling-oriented design and production

To develop design, construction and production technologies that enable industrial products, food circulation resources, constructions, etc., to embody 3R in the design and production stages.

iv. Program for developing technologies and systems for appropriate waste processing and disposal

To develop technologies and systems for addressing the urgent task of dissolving shortage of final waste landfills and inappropriate waste processing, and dissolving negative heritage, including disused products, illegal dumping, and contaminated land caused by inappropriate waste processing.

(3) R&D for eco-harmonic regeneration of urban and river basin areas

(a) Overall target

As a contribution to drawing up specific plans to achieve a eco-harmonic society in major cities and river basin regions, to develop systematically technologies and systems for regenerating such areas, and to design and present a scenario for achieving eco-harmonic cities while controlling the sprawling expansion of urban areas.

(b) Target of individual programs

i. Program for monitoring the urban and river basin environments

To make a comprehensive observation and diagnosis of the environment, including the condition of water and material circulation and ecosystems, in model cities and river basin areas including urban, agricultural, mountain and fishing communities. Also, to collect past and present data from across the nation on urban and river basin regeneration and management, and develop a comprehensive data system on the environment.

ii. Program for developing the urban and river basin management model

Based on identifying the processes associated with changes in water and goods circulation, ecosystems, etc., of river basin communities including urban, agricultural, mountain and fishing areas and analyzing human activities in such areas, to develop models for predicting environmental change, make impact assessments and develop an integrated urban and river basin community management model.

iii. Program for exploring eco-harmonic technologies

To develop eco-harmonic technologies and systems for preserving a good natural environment in river basin communities including urban, agricultural, mountain and fishing areas, remedying jeopardized ecosystems, and improving deteriorated living space.

iv. Program for preparing and implementing scenarios for the creation of a eco-harmonic society

To present basic concepts of social systems, i.e. human activities essential to developing a eco-harmonic society in river basin areas including urban, agricultural, mountain, and fishing communities, and to design and present technological and policy scenarios concerning remedying and regenerating the environment.

(4) R&D for comprehensive risk management of chemical substances

(a) Overall target

To define subject chemical substances in those which require urgent risk management (e.g., substances subject to PRTR), and develop the technological foundation, knowledge structures, and intellectual

foundation, for comprehensive management of chemical substances to ensure “safety and security”. Based on the results, to develop a system for risk assessment and management that facilitates communication of the risk associated with the subject chemical substances across the social hierarchy within 10 years (by 2012).

(b) Targets of individual programs

i. Program for developing risk assessment systems

To achieve efficient prediction and monitoring, and to improve the technologies for exposure assessment, and hazard assessment to humans and ecosystems, using innovative measuring technologies and environmental behavior modeling. To systemize the acquired knowledge to facilitate priority evaluation of risk reduction, and to set a direction toward accurate risk minimization so as to develop comprehensive technologies for effective and efficient risk assessment.

ii. Program for developing risk reduction technologies

To establish technologies for reducing discharge of chemical substances, develop the foundations of environmentally friendly production technologies, and establish a system for best available technologies. At the same time, to establish the basic fundamental technologies for remedying and detoxifying chemical contamination of the environment (soil, underground water, deposits).

iii. Program for developing risk management methods

To build an information system to support the comprehensive management of chemical substances through systemizing scientific knowledge on chemicals. Also, to develop social and policy risk management methods including a systemized knowledge base for risk communication.

iv. Program for developing intellectual infrastructures

To develop a data storage and management system and to develop and preserve standard experimental organisms, while building a system for preserving acquired samples so as to create a specimen banking system that can disseminate information to the world.

(5) R&D for global water circulation changes

(a) Overall target

To present scientific knowledge and a technological foundation for

establishing water management methods for averting or minimizing the adverse effects of changes in water supply, demand, and circulation, and facilitating sustainable development into the future. Based on this knowledge and foundation, to propose optimum water management methods for the Asian region.

(b) Targets of individual programs

i. Program for observing global water circulation

To promote systematic observation activities (satellite observation, marine observation, land surveys and monitoring, etc.) and develop a global system of water circulation observation to enable mutual use of observation data. Also, to promote the accumulation of data in Asian monsoon areas, etc.

ii. Program for developing the model of water circulation changes

To develop a model for projecting water circulation changes associated with fluctuations in water supply and demand and with climate changes. Also, to create a scenario for analyzing the trends of human activities that affect water circulation, so as to form the basis for a model capable of projecting water circulation changes and accompanying environmental changes.

iii. Program for assessing the impact on human society

Based on the projection of water circulation changes and accompanying environmental changes, to make a quantitative assessment of their impact on food, water resources, ecosystems, human health, society and the economy.

iv. Program for making a comprehensive evaluation of countermeasure scenarios and technological development

With the objective of achieving optimum water management, to make applicability assessments of existing technologies, develop new technologies, and present countermeasure scenarios.

(6) Intellectual research infrastructure in the environment field

To enhance and advance intellectual infrastructures for environmental research to a level where broader usage is possible.

(7) Promotion of pioneering research

To develop innovative knowledge and new research paradigms for resolving environmental issues.

4. Basic Issues for Promoting R&D

(1) Priority issues for improving the quality of R&D

(a) System for promoting and evaluating the initiative

To enable efficient and effective promotion of the initiative and of individual programs or projects, the Council for Science and Technology Policy must exercise strong leadership in building a mechanism that defines the responsibilities and authorities of each level, and establish an evaluation system whereby appropriate evaluation and assessment results are reflected in resource distribution, etc.

(b) International cooperation

With the key environmental tasks having shifted to domestic and international socio-economic activities, international cooperation is essential to promote scientific and technological research into the environment. For this reason, priority research must be conducted effectively and efficiently, pursuing the possibility of international cooperation with the United States, Europe, etc. Cooperation with developing countries should also be promoted from the perspectives of human resource development, ability enhancement, etc.

(c) Proliferation of R&D

Priority tasks should be conducted toward the clear goal of contributing to the resolution of environmental issues. Research findings must be actively reflected in environmental policies, and a system for facilitating this needs to be developed. Also, efforts should be made to help the general public understand the necessity of R&D and to win their cooperation, so that they can see and work toward the future with a sense of security.

(d) Tri-sector partnership and role distribution

In the environment field, the scientific knowledge and technology of various fields are combined together according to social needs. This makes it extremely inefficient and unproductive for a single entity to handle all aspects of R&D. Public sector or academic laboratories should take charge of themes that do not conform to the market principle, themes involving high risks or costs in research investments as well as more basic or fundamental themes, whereas

the private sector should take the initiative in applied research for practical application. Based on this approach, we must promote R&D and technological proliferation under partnership and role distribution among industry, academia and government.

(e) Coordination with local initiatives by regional governments, NGOs, etc.

Environmental problems arise according to the state of each region's natural environment, society and economy. In exploring themes with regional characteristics, it is therefore effective to strengthen ties with regional governments and university laboratories that conduct R&D on region-specific environmental issues, or with private enterprises, NGOs, etc., that are actively addressing such problems.

(2) Resources required in R&D

(a) Enhancement and expansion of competitive funds

Competitive funds must be further enhanced and expanded to broaden research fund options and develop a competitive R&D environment, thus enabling the smooth implementation of research in pioneering areas, or the addressing of emergency situations.

(b) Human resource development

In order to promote environmental research effectively and efficiently, it is important to secure and develop human resources in addition to expanding research funds. We must enhance the domestic and international research networks of independent administrative institutions, universities, and environmental research institutes (private or regional government affiliated), while introducing more flexible research systems, a fellowship system, and an invitation system for overseas researchers. In addition, we must support the effective use of museums, NGOs, and other organizations with a high potential, as well as newly established or reorganized universities and postgraduate schools focusing on environmental studies, while actively seeking to use the human resources provided by such organizations.

(c) Coordination with other fields

The environment field typically consolidates methods and technologies from various other fields according to social needs and

demands. Therefore, the trends of new methods and technologies in other fields must be observed and actively applied to the environment field, so as to create a new paradigm in environmental studies.

(d) Developing large facilities dedicated to environmental studies

It is necessary to develop large-scale experimental facilities capable of reproducing various environmental conditions, to acquire the world's cutting-edge analysis devices, and to prepare outdoor research facilities for long-term and continuous observation.