Chapter 1
Sustainability and Quality of Life

Section 1 Trends in Sustainability and Quality of Life

1. The Origins of the Earth's Resources

It is believed that the early solar system was born from cosmic dust and gas. This dust and gas, which was collected in one place, caused nuclear fusion that converted hydrogen into helium, and the sun began to shine in the center of the solar system. Meanwhile, some of the dust encircling the sun gathered and became planetesimals, then came together and evolved into planets, including the early Earth. (Figure 1-1-1).

Figure 1-1-1 Early Solar Disk

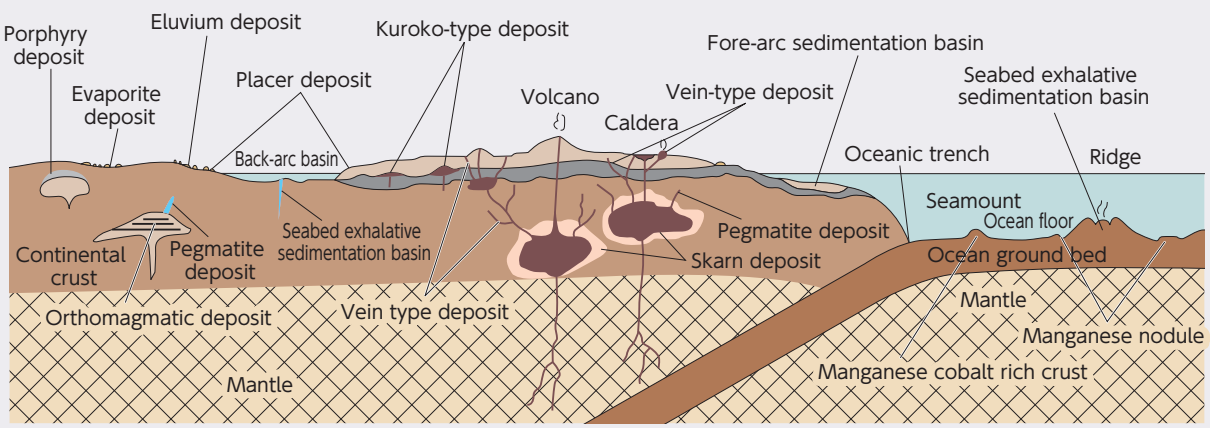
Source: NASA/JPL-Caltech

Various atomic elements were included in the huge number of asteroids and meteors that impacted the Earth in the process of the birth of the early Earth. The mineral resources that originate from astronomical objects support our current social and economic activities.

It is thought that the surface of the early Earth melted due to the impacts of the asteroids and meteors, and was in an intense-heat condition as a magma ocean. The melted magma cooled and hardened, and the early continental shelf and ocean were formed. In these processes, metals such as heavy iron that were originally contained in the planetesimals moved into the inner core of the Earth. Subsequently, the current earth deposits were formed by activity of volcanoes and water (Figure 1-1-2). As for rare metals such as platinum, because much of them moved to the Earth's core 4.5 billion years ago, the rate of content in the crust is now low.

Rare earth deposits, whose value has been recognized in recent years because of their increasing demand, were either accumulated in magma reservoirs by volcanic activity, or accumulated by absorption on clay particles.

Figure 1-1-2 Various Places where Ore Deposits are Formed



Source: "Introduction to the Earth and Planetary Science," edited by Kazunori Arita, Toru Takeshita, Shoshiro Minobe, and Shigeto Watanabe

In the former case, rare earth elements are sometimes mixed with radioactive elements such as uranium and thus are difficult to handle. In the latter case, they are comparatively easy to handle, but are very scarce because they only exist in extremely limited regions such as China.

It is thought that the first life forms arose from organic compounds in the early oceans approximately 4 billion years ago. Photosynthetic organisms such as blue-green algae appeared 3.9 billion years ago, and the oxygen level in the atmosphere of the early Earth started to increase. The oxygen then formed the ozone layer encircling the Earth, and protected the Earth from the sun's ultraviolet radiation. Because the atmospheric composition became similar to the current one and the climate became stable, the foundation of terrestrial ecosystem had been constricted. Subsequently, plants moved onto land and ancient forests grew, and animals moved into the terrestrial ecosystems. These dynamics caused terrestrial ecosystems to be complex.

Fertile soil was created from the organic matter produced by those plants and animals. The organic matter mainly in the ocean got buried deep underground by movements of the plates, and strong pressure and enormous amounts of heat caused the organic matter to turn into the fossil fuels such as oil and coal that support our human activities today.

The various resources that we today obtain from the Earth were created over a long time since the Earth was born, and therefore they are limited. Mineral resources and fossil fuels are non-renewable on the human time scale, and they are biological resources that will be lost forever unless they are used in a sustainable way.

Column The Asteroid Itokawa and the Earth

Our solar system consists of the Sun, eight planets and their satellites, and many small celestial bodies such as asteroids and comets. Counting only the asteroids and other small celestial bodies whose orbits are calculated, there are as many as 100,000, mostly existing between the orbits of Mars and Jupiter.

Except for the moon, humans have never landed directly on celestial bodies and obtained rocks and fine particles from them. Because large celestial bodies such as the Earth and the Moon have changed in composition significantly since their birth until today, it is not possible to know the composition of substances in the early stage of the solar system. If technology were available to bring back samples from asteroids (so-called "sample return") which have a comparatively fixed record of the composition of substances when the planets were born, it would be possible to obtain clues about the materials that created planets and asteroids.

The Japan Aerospace Exploration Agency (JAXA) probed the asteroid "Itokawa" in a mission of the asteroid explorer "Hayabusa (MUSES-C)" launched in May 2003.

Source: The Japan Aerospace Exploration Agency (JAXA)

Detailed observation by Hayabusa found that Itokawa is a small celestial body of 540m in longest diameter and an average diameter of 320m, shaped like a sea otter floating on the ocean, with a surface comprising areas where rocks are exposed and areas where sand and gravel are accumulated.

This "Hayabusa" mission achieved a variety of results, such as the operation of an ion engine, a rendezvous with Itokawa using autonomous optical navigation for landing on asteroids, and various scientific observations of Itokawa. One of the greatest results was that it successfully brought particles from Itokawa's surface back to the Earth.

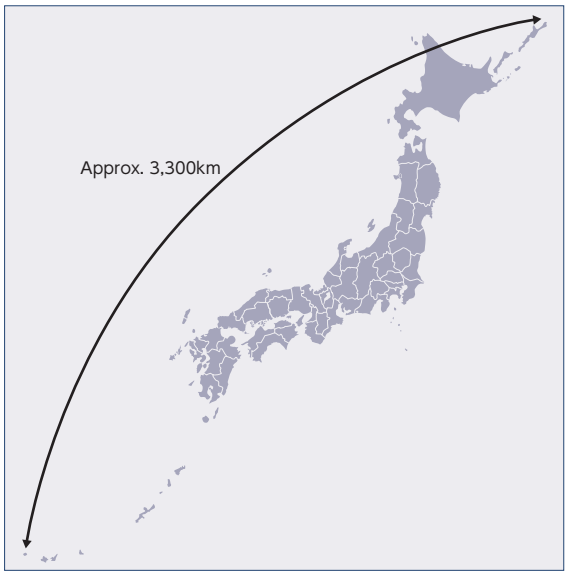
The fine particles were collected from the capsule that returned to the Earth in June 2010.

Some of the particles were identified as rocky particles by observation using an electron microscope. They have been under a series of physical and chemical analysis of things such as particle surface and inside composition, elemental composition, existence of macromolecular organic complexes and the types and content of mineral substances. It is expected that from the results of such analysis we will be able to obtain extremely valuable scientific knowledge related to the birth of the Earth.

When Hayabusa landed on Itokawa in September 2005, Itokawa was in a position approximately 320 million kilometers away from the Earth. To make an analogy of the space traveling of Hayabusa (1m x 1.6m x 2.0m), it was precision work as if an approximately 0.02mm grain of sand ("Hayabusa") launched from the northernmost point of Etorofu Island in Hokkaido directly hit a grain of rice approximately 5mm long ("Itokawa") situated at the westernmost point of

Yonaguni Island in Okinawa Prefecture, and then again returned to Japan's northernmost point.

Japan has thus contributed substantially to the world with the highest level of science and technology in order to study the history of the Earth and learn the paramount importance of the planet we live on.

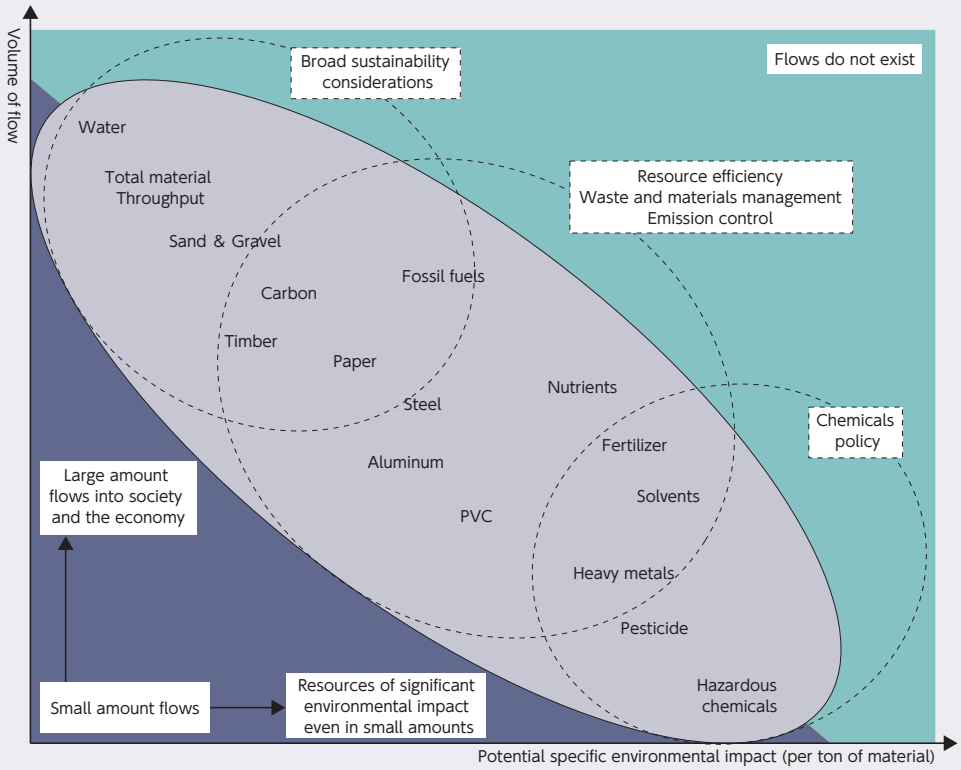


2. Sustainability and Quality of Life in Our Daily Lives

The Earth has limited resources such as fossil fuels, minerals and land, and renewable resources such as water, air, and biomass produced by living organisms. It also has energy resources absorbed from outside the Earth, such as sunlight, and those that the Earth has inside itself, such as geothermal energy. Our better lives and life satisfaction are based on these natural resources of the Earth. In our social and economic activities, we are repeating the process of taking materials, using them, and then discharging the wastes and greenhouse gases into the Earth.

Some activities cause almost no impact on the environment and some cause significant impacts on the environment, such as emission of pollutants. However,

Figure 1-1-3 Amount of Materials and Potential Environmental Impact



Source: Created by the Ministry of Environment, based on *Measuring Material Flows And Resources Productivity* Volume 1. The OECD Guide

in the process of our daily activities today, there is an increasing trend that we use a lot of resources for mass production, consume a large amount of products, and then dispose a large amount of waste, with significant impacts on the environment (Figure 1-1-3). We must consider that these impacts have negative affects on not only our daily lives but also on biodiversity.

For our better lives, there are two important viewpoints for considering the sustainability of the Earth: the limitation of non-renewable resources, and the value of biodiversity that can never be brought back once they are lost.

In the following subsection, we will give an overview of the progress in international awareness about sustainability and quality of life, and the world's efforts aimed at evaluating such awareness, and we will also discuss the status of sustainability and quality of life around the world and in Japan, focusing on environmental aspects.

3. Progress in International Awareness about Sustainability and Quality of Life

(1) The World History of Moving toward a Sustainable Society

In the 1960s to the 1970s, while environmental pollution became a large social problem in developed countries, the urgent task in developing countries was to break free from poverty. Amid such circumstances, in 1972 the United Nations Conference on the Human Environment was held in Stockholm. Based on the Stockholm Declaration, a framework for agreement and actions in order to promote environmental conservation were formed. However, there were conflicts between developed countries and developing countries over the awareness about environmental problems. The developed countries continued their lifestyle of mass production, mass consumption, and mass disposal and further expanded economic activities, while developing countries prioritized development in order to break free from poverty. This was development that could not be called sustainable.

Around this time, however, predictions about the future of humankind, such as the "Limits to Growth" (a report of Club of Rome) and the "Global 2000 Report to the President" (a report of the United States), were published, clarifying the limits of the resources on the Earth and environmental constraints, and greatly shocking the people of the world.

What triggered the establishment of the term "sustainable development" was the report "Our Common Future" by United Nations World Commission on Environment and Development, which had been established by the United Nations based on a proposal by Japan.

The "United Nations Conference on Environment and Development (the Earth Summit)" was held in Brazil's Rio de Janeiro in June, 1992, and an action program for sustainable development was adopted. At this Earth Summit, countries adopted the "Rio Declaration on Environment and Development," which is a principal of action toward sustainable development, and "Agenda 21," which is an action plan for the declaration. The United Nations Framework Convention on Climate Change, which was a decision for each country to cooperate with efforts to prevent global warming, and the Convention on Biological Diversity, which was a decision in order to conserve biodiversity and use it sustainably, were adopted by consensus. With such movements in the background, the concept of "sustainable development" became widespread throughout the world.

After that, international discussions about global warming proceeded, and in 1997 the Kyoto Protocol was adopted at the 3rd Conference of the Parties to the United Nations Framework Convention on Climate Change that was held in Kyoto. In 2008, at the G8 Hokkaido Toyako Summit, the leaders of developed countries made declarations about global warming, including the goal of achieving at least a 50% reduction of global emissions by 2050.

Meanwhile, international movements concerning preservation of biodiversity and sustainable use also became active, and in 2002 the Johannesburg Declaration on Sustainable Development was politically declared at the Johannesburg Summit held in Johannesburg, South Africa. The 6th Conference of the Parties to the Convention on Biological Diversity (COP6) was held at The Hague in the Netherlands, and the 2010 Biodiversity Target of reducing the rate of loss of biodiversity by the year 2010 was decided upon. In October 2010, which was the year for achieving that target, the 10th Conference of the Parties to the Convention on Biological Diversity (COP10) was held in the City of Nagoya, Aichi Prefecture, and the "Aichi Targets," which would become new worldwide targets for preserving biodiversity, and the "Nagoya Protocol," which concerns access to genetic resources and benefit sharing (ABS), were adopted.

(2) Worldwide Efforts for Monitoring & Evaluation of Quality of Life and Sustainability

As concerns about sustainability increase, it becomes important to consider what true quality of life and sustainable development are. Although there are many different points of view concerning sustainable development, one of the widely accepted definitions is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," which was indicated in the previously mentioned report "Our Common Future." Under this perspective, the world has made efforts for reconsideration of methods for measuring conventional development by scale of economic activity. That served as a trigger for spreading awareness of the necessity of measuring not only the scale of economic activity but also true quality of life, and the necessity of evaluating quality of life not only for the current generation but also that for the next generation.

Thus, in addition to the efforts for achieving sustainability, international organizations such as

Table 1-1-1 Major International Actions toward a Sustainable Society

Year	Name of the Treaty, Conference, or Documents and Publication	Notes (location, etc.)
1972	United Nations Conference on the Human Environment, Stockholm Declaration	Location: Stockholm, Sweden
	The Limits to Growth	By: The Club of Rome
1980	*The Global 2000 Report to the President*	By: The government of the United States
1987	*Our Common Future*	By: The United Nations World Commission on Environment and Development
1992	The United Nations Conference on Environment and Development (Earth Summit) The Rio Declaration on Environment and Development, "Agenda 21"	Location: Rio de Janeiro, Brazil
	The Convention on Biological Diversity	
	The United Nations Framework Convention on Climate Change	
1997	The 3rd Conference of the Parties to the United Nations Framework Convention on Climate Change "Kyoto Protocol"	Location: Kyoto City, Kyoto
2000	The United Nations Millennium Summit Millennium Development Goals (MDGs)	Location: New York, USA
2002	World Summit on Sustainable Development (Johannesburg Summit)	Location: Johannesburg, South Africa
	The 6th Conference of the Parties to the Convention on Biological Diversity	Location: The Hague, Netherlands
2008	G8 Hokkaido Toyako Summit	Location: Toyako-cho, Hokkaido
2010	10th Conference of the Parties to the Convention on Biological Diversity	Location: Nagoya City, Aichi

Source: Ministry of the Environment

the Organisation for Economic Co-operation and Development (OECD) and the United Nations have discussed development of indicators for measuring sustainability and quality of life, which has become an international trend (Table 1-1-2).

Under the United Nations Development Programme (UNDP), since 1990 the degree of human development has been measured by using the Human Development Index (HDI), which is a composite indicator that gives weight to and calculates individual values for income, life expectancy, literacy rate and schooling and education standards.

The "Genuine Savings" indicator developed by the World Bank in 1998 is a sustainability indicator that builds on the concepts of green national accounts, which take into account investments in human capital, depletion of natural resources and damage caused by pollution and carbon dioxide emissions. If genuine savings are negative, it means that there is a reduction of overall wealth, and that the current level of consumption is not sustainable.

The OECD has been publishing "Society at a Glance – OECD Social Indicators," "OECD Key Environmental Indicators," "Economic Policy Reforms: Going for Growth," and other various indicators related to the environment, the economy, and society to evaluate the status of progress of international society. These indicator sets have become widespread around the world as the basic indicators for measuring development.

In addition, at World Forums hosted by the OECD with the cooperation of the World Bank, the EU, the United Nations, and other organizations, efforts have been taken to measure society's progress and human development. In Istanbul, Turkey, the second forum was held, and the "Istanbul Declaration (2007)" was signed. This declaration proposed recommendations for developing indicators in order to measure society's progress.

There are movements to reconsider GDP, which has been used to measure the scale of economic activities. Even if GDP indicates a country's income, it sometimes presents movement that differs from the degree of life satisfaction that people actually feel, due to factors such as that the status of household income is not sufficiently linked to GDP, that elements such as the quality of services and goods considered necessary for measuring human well-being are not included, that it is difficult to grasp housework and leisure that have not been commercialized, and that GDP focuses on short-term economic activity and does not emphasize long-term accumulation of capital such as natural resources and human capital.

The "Beyond GDP Conference," which comprises the European Commission, European Parliament, the Club of Rome, the OECD, and the World Wildlife Fund (WWF), is trying to define indicators that are optimal for measuring society's progress. This conference has discussed in order to have such indicators utilized in the public's decision-making and in policy-making. In 2009 the conference's results were published and five key actions for improving indicators to measure society's progress were announced as below:

1. Complementing GDP with environmental and social indicators
2. Near real-time information for decision-making
3. More accurate reporting on distribution and inequalities
4. Developing a European Sustainable Development Score-

Table 1-1-2 Indicators Set by International Organizations in Order to Measure the Status of the Environment, the Economy, and Society

Year	Party that Announced the Indicator, Etc.	Product	Objectives, Content
1990-	The United Nations Development Programme	Human Development Index (HDI)	An integrated indicator that targets 175 countries of the world for global assessment of countries' achievements in different areas of human development
1996		Sustainable Development Indicators (CSD indicator)	A set of 14 indicators that target 53 states and focus on sustainable development and assist decision-makers at all levels to adopt sound national sustainable development policies
1998	The World Bank	Where is the Wealth of Nations? Measuring Capital for the 21st Century	An evaluation of sustainability by using indicators such as genuine savings to measure the savings in an economy after taking into account investments in human capital, depletion of natural resources and damage caused by pollution
2000-	OECD	Society at a Glance - OECD Social Indicators	A set of indicators for providing quantitative data on social equality, health, and social cohesion in OECD countries, in the general context of society, self-sufficiency, equality of income distribution, social welfare, and social cohesion (e.g. crime rate, suicide rate, life satisfaction)
2001-	OECD	OECD Key Environmental Indicators	A set of indicators for supporting evaluation of the status of OECD countries' environmental policy progress and political measures, and providing information to the public sectors (climate change, ozone layer, air quality, waste generation, freshwater quality, freshwater resources, forest resources, fish resources, energy resources, biodiversity)
2004-	OECD, the World Bank, EU, the United Nations, etc.	World Forum	A world-wide forum for encouraging awareness of what constitutes society's progress and assessment of progress of well-being. The first meeting was held in Palermo, Italy (2004). At the second meeting the Istanbul Declaration (2007), which proposed recommending development of indicators to work for social progress, was published. The third meeting (2009) was held in South Korea
2005-	OECD	OECD Factbook	A set of indicators providing a global overview of trends in the economy, society, and the environment, based on OECD statistics (population, GDP, consumer price indices, primary energies, gender ratios in employment, expenditures for research and development, international student assessments, public finance, life expectancy, emigration, etc.)
	OECD	Economic Policy Reforms: Going for Growth	A set of indicators for indicating a country's performance in relation to improvement of labor productivity and employment (product market regulation indicators, human capital, labor market, labor tax, labor market policies, etc.)
2007-	The European Commission, the European Parliament, the Club of Rome, OECD, WWF	Beyond GDP Conference	A conference for defining indicators that are appropriate for measuring society's progress, and how those indicators can be integrated in public decision-making
2009	OECD	Government at a Glance 2009	A set of statistics for evaluating government activities and performance and assessing fundamental issues of good governance (e.g. data related to government income, expenditures, and hiring)
	Commission on the Measurement of Economic Performance and Social Progress (CMEPSP)	CMEPSP Reports	Proposal of a system of indicators, requested by French President Sarkozy, for identifying the limit of GDP and measuring economic, environmental, governmental, and social quality of life and sustainability, focusing on the future and the current generation

Source: Created by the Ministry of the Environment, using the CMEPSP report "Survey of existing approach to measuring socio-economic progress," materials from the Cabinet's first Study Group for the level of happiness (December, 2010), etc.

board

5. Extending National Accounts to environmental and social issues

As requested by France's President Sarkozy, based on awareness of the limits of GDP and the need for measuring sustainability and quality of life, the Commission on the Measurement of Economic Performance and Social Progress (CMEPSP) has been established. A report by the Commission proposed indicator systems in order to measure quality of life and sustainability in environmental, economic, and social aspects. It also pointed out that there are various difficulties and that indicators are imperfect, because using a composite indicator is not enough for measuring quality of life and sustainability, since the way in which various items are weighted is arbitrary and the messages of results are ambiguous.

The report presents an approach that incorporates the idea that sustainability is securing quality of life for future generations.

The following examples of methods were given as ways of measuring sustainability:

1) Development of composite indicators,
2) Dashboards or sets of indicators that gather and put in order series of indicators,
3) The System of Environmental Economic Accounting (SEEA), that account for the impact of the economy on the environment,
4) Adjusted net savings (ANS), also known as genuine savings, to measure the savings in an economy after taking into account investments in human capital, depletion of natural resources and damage caused by pollution, and
5) Environmental footprints, which measure the regenerative capacity of the biosphere.

The report proposes that it is important to use indicator dashboards that gather and put in order series of indicators, and proceed with measurement of stocks.

The report also suggests three ways of evaluating quality of life (QoL). The first is a subjective approach that evaluates people's satisfaction with their daily lives as a whole and then analyzes the results. The second is a

Table 1-1-3 France's 2010 -2013 Nine Strategies and New Indexes for Sustainable Development

	Highlight Index (Level 1)	Supplementary Index (Level 2)
Socio-Economic Background	0.1 Domestic gross income per person and GDP / citizen (EU) 0.2 Unemployment rate and underemployment 0.3 Income distribution 0.4 Birthrate	
Strategy 1 - Sustainable Consumption and Production	1.1.1: Productivity of raw materials	1.2.1: Change in waste generation; Biannual measurement at source, by type of waste 1.2.2: Percentage of waste recycling 1.2.3: Ratio of SAU in organic agriculture (goal: 20% in the year 2020) 1.2.4: Employment rate in eco-activities
Strategy 2 - Knowledge Society	2.1.1: 18 to 24 year olds who leave school before obtaining a graduation diploma 2.1.2: Percentage of research and development in GDP	2.2.1: Ratio of young people who have difficulties in reading 2.2.2: Comparison of the number of people who have obtained high school diplomas in the age groups 25 to 34 and 25 to 64 2.2.3: Ratio of people who pursue continuing education, by age group and social position 2.2.4: Barometer of knowledge in each household about the concept of sustainable development
Strategy 3 - Governance	3.1.1: Rate of participation by women in the upper levels of governance : Ratio of members of the Upper House	3.2.1: Rate of participation in the previous election of the same type 3.2.2: Participation in group activities (every two years since 2006) 3.2.3: Number of measures against climate change in local areas and the local version of Agenda 21
Strategy 4 - Climate Change and Clean Energy	4.1.1: Amount of greenhouse gas emissions (EU) 4.1.2: Carbon debt : In final domestic demand	4.2.1: Ratio of energy consumption per resident to GDP for energy consumption 4.2.2: GES emissions by sector
Strategy 5 - Sustainable Transport and Mobility	5.1.1: Energy consumption for transportation per resident	5.2.1: Distribution of transportation by type (car, bus, railroad, airplane) 5.2.2: Ratio of use of public transportation : Ratio against the total number of ground travelers 5.2.3: Distribution of transportation by type for commercial use 5.2.4: Amount of emissions of exhaust pollutant materials from transportation (NOX and aerosol)
Strategy 6 - Sustainable Conservation and Management of Biodiversity and Natural Resources	6.1.1: Number of wild birds (EU) 6.1.2: Change in ratio of land made artificial	6.2.1: Ratio of fishing resources for fish catches (EU) 6.2.2: Water quality analysis index for surface water 6.2.3: Consumption of phytosanitary products
Strategy 7 - Public Health, Risk Prevention and Management	7.1.1: Average life expectancy by occupation and average life expectancy of those who were born healthy (EU)	7.2.1: Accidents in the workplace 7.2.2: Work-related illnesses 7.2.3: Ratio of people unable to receive desired medical care (due to economic circumstances) 7.2.4: Suicide rate 7.2.5: Waste from nuclear power (every 3 years)
Strategy 8 - Demographics, immigration and social inclusion	8.1.1: Rate of economic poverty after social movement (EU) 8.1.2: Comparison of employment rates among older people for the age groups 55-64 and 55-59 8.1.3: Young people's assimilation into society: Ratio of people aged 16 - 25 who are not in education, employment, or training	8.2.1: Number of households with excessive debt 8.2.2: Unprivileged living environment (payment arrears, difficulty obtaining housing, restrictions on consumption, etc.) 8.2.3: Overpopulation in housing environment 8.2.4: Salary disparities between men and women 8.2.5: Ratio of long-term unemployed people 8.2.6: National debt (against GDP), and corporate and household debt 8.2.7: Population composition by age
Strategy 9 - International challenges of sustainable development and the fight against world poverty	Development assistance by public organizations	Ratio of imported goods in domestic resource consumption

Note: "EU" within the table denotes indicators that use indicators common throughout the European Union
Sources: "Les indicateurs de la strategie nationale de developpement durable 2010-2013 from France's Ministry of Sustainable Development
"FY 2010 Policy Research on the Environment and the Economy" (Professor Masaharu Yagishita, Yuki Nishiguchi, et al. Sophia University) from the Ministry of the Environment

capability approach that conceives an individual's life as a combination of the various "doings and beings" (functioning) and his or her freedom to choose among that functioning (capability). The third approach is a welfare economics approach, based on theories of welfare economics, of weighting non-monetary dimensions of QoL in respect to people's preferences, such as fairness of income distribution.

Although these approaches are different, they also have similarities with each other. When measuring QoL it is important to focus on measurement of subjective elements (the individual situation and the person's actual feelings) and measurement of objective elements (health, education, individual activities such as leisure, status of governance, social connections, status of the environment, personal safety and peace of mind).

Further, based on these results, the Ministry of Sustainable Development of France adopted a National Sustainable Development Strategy for the period from 2010 -2013, including nine key challenges and indicators (Table 1-1-3).

As seen above, all these discussions about GDP's usefulness and its limitations, measurement of QoL, and measurement of sustainable development aim to establish an important evaluation method in order to achieve sustainability and life satisfaction so that future and current generations can both enjoy their lives. We expect that international discussions that include Japan will continue in the future.

In the next section, we will provide an overview of the sustainability and QoL of the Earth and Japan, mainly in terms of the environment.

Column

Small is Beautiful

Man is small and, therefore, small is beautiful.
"Small is Beautiful" by Ernst F. Schumacher

Schumacher published "Small is Beautiful" in 1973, based on awareness of the problem of how to secure and expand humanity in modern society. This book coincided with the environmental pollution that became a social problem mainly in developed countries. At the same time, the United Nations Conference on Human Environment was held in Stockholm and the Stockholm Declaration was adopted (1972), and the world was trying to move forward toward building a framework for a sustainable society on a global scale. However, there still were continuous mass production, mass consumption, and mass disposal, in a way that could not be called sustainable. The book says that these human activities and technologies cause a crisis of eating up limited natural resources.

The book says that people find little satisfaction and lose their humanity because such modern style of production splits the work that used to achieve humanity and life satisfaction into pieces of work. This is the first crisis that the world faces. The second crisis is the ones of the environment that supports human life but now is showing signs of collapse. The third crisis is the depletion of natural resources.

Schumacher writes that we should create "intermediate technology" that is appropriate for humans. This way of thinking is summarized by the words "Man is small and, therefore, small is beautiful," which became the title of the book.

In this book, Schumacher also makes some epigrams. Schumacher sais that it is too optimistic to expect that we can deal with the destructive forces by solving environmental destruction, conserving wildlife, discovering new energy and achieving agreements on peaceful coexistence.

The moral choices, he says, are necessary and it is possible to obtain justice (justitia), courage (fortitudo), and temperance (temperantia) with knowledge (prudential).

These are virtues that are absolutely essential for the continued existence of civilization.

Section 2 Evaluation of Sustainability and Consideration of Quality of Life

1. The Current Status of the World' s Sustainability

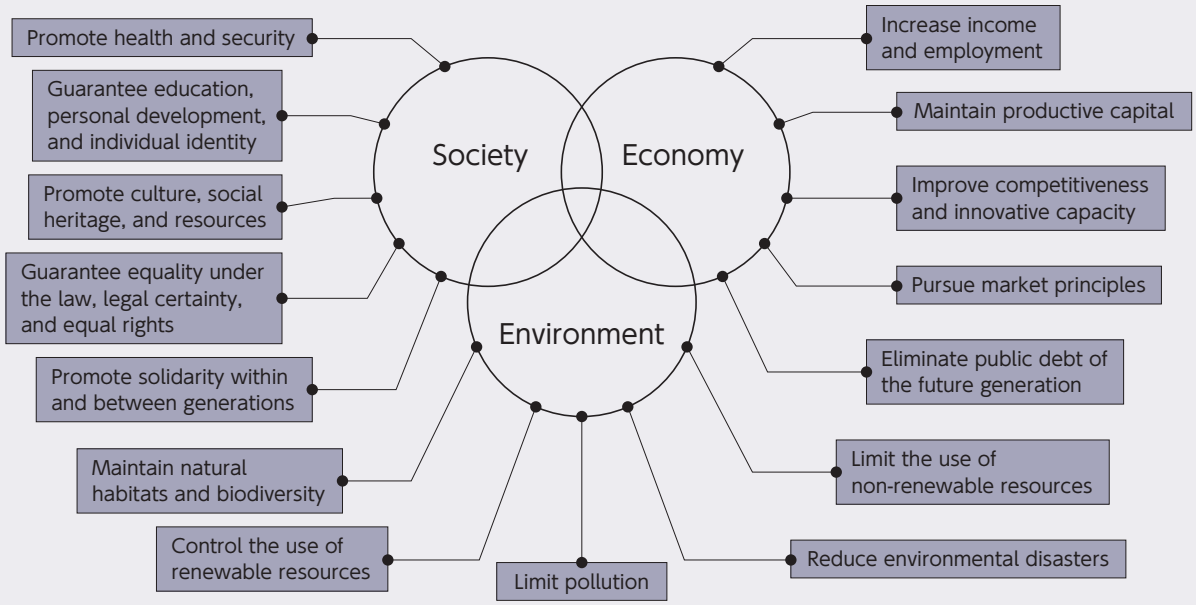
"As seen in the previous section, the life satisfaction is based on stability of the following three viewpoints: sustainable environment, economy and society." In order to evaluate whether human life is sustainable or not, it is necessary to consider whether each of the following systems have been established and maintained: an environmental conservation system that allows the consumption of natural resources at an acceptable level of the Earth's environment (environmental sustainability), an economic system that enables fair and appropriate economic activities (economic sustainability), and a social system that will ensure fundamental human rights and cultural and social diversity (social sustainability) (Figure 1-2-1).

In this sense, it is possible to think that the environment is the foundation of our society and the economy, because if environmental sustainability is lost, it will lead to degradation of our life and depletion of natural resources, which would affect social and economic sustainability.

Dynamics in society and the economy affects the environment. For example, demographic dynamics is one example of important worldwide social changes in recent years. The world's population, which was 3.7 billion in 1970, sharply rose to 6.8 billion in 2009. According to estimation by the United Nations Population Division, the increase of the world's population has continued driven thus far by population increases in China and other East Asian countries, and India and the other Central and South Asian countries. From today until 2050, the population increase in East Asia will slow down, but the population in Central and South Asia will continue its remarkable increase, and the population increase in Africa will accelerate (Figure 1-2-2).

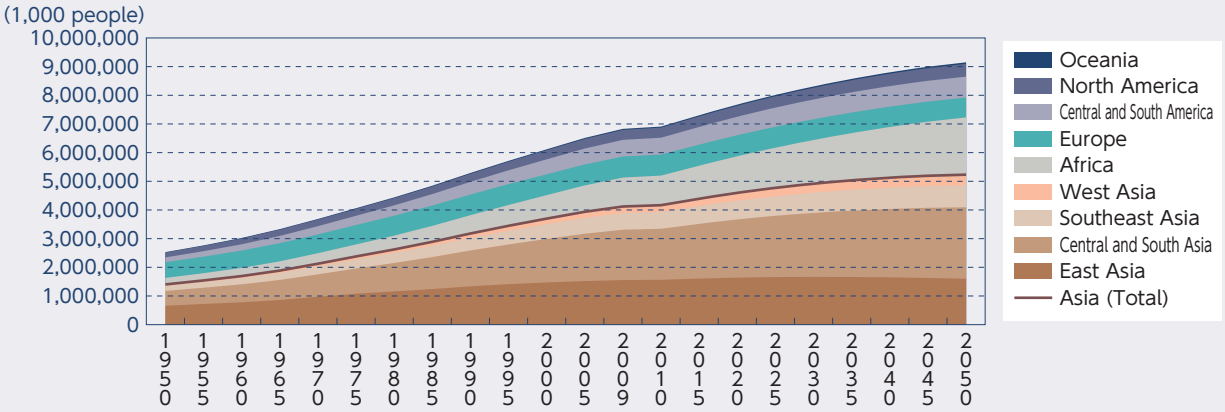
As for economic trends from 1970 to 2009, China had particularly remarkable growth in GDP, and Asia's economy is growing, mainly in East Asia (Figure 1-2-3). Meanwhile, in Africa, GDP is not growing in comparison

Figure 1-2-1 Three Aspects Related to Sustainability



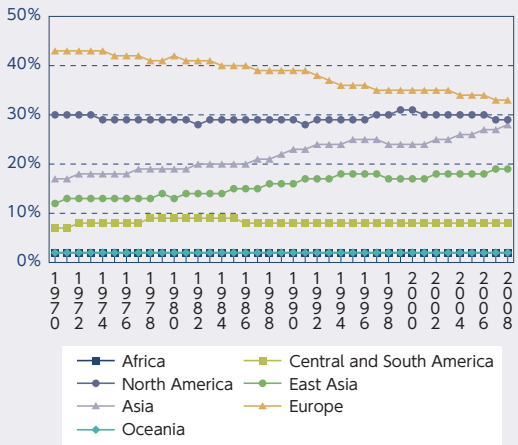
Source: Created by the Ministry of the Environment, based on information from Swiss Sustainability assessment

Figure 1-2-2 Changes in the World's Population



Source: United Nations Population Division

Figure 1-2-3 Trends in World GDP Ratios (By Region)



Source: United Nations Statistics Division
GDP/breakdown at constant 2005 prices in US Dollars (all regions)

to the trend of population growth, the ratio of poor people who live on USD1.25 or less per day surpassed 50% from the 1980s until 2005, and socio-economic inequality continues to expand on a global scale (Figure 1-2-4).

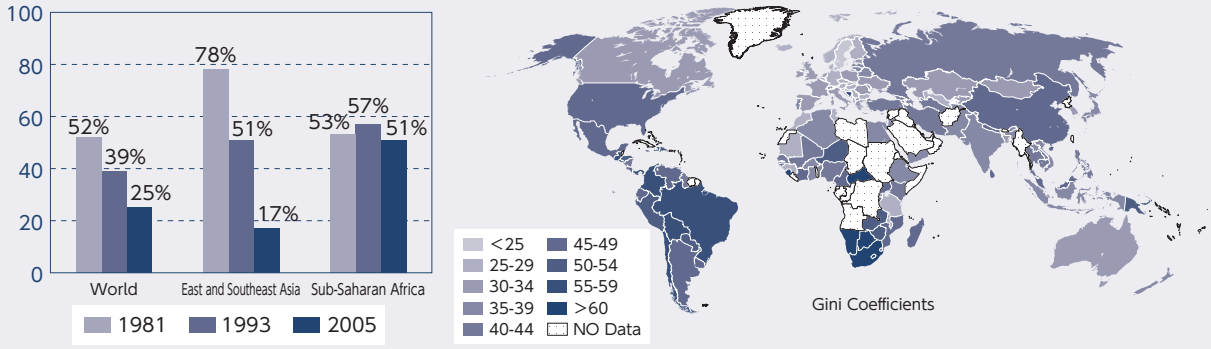
We will now discuss environmental sustainability from the viewpoint of how such dynamics in the socio-economic situation affect the environment.

(1) Energy Supply and Global Warming

Here we will look at global warming, as an example of impacts on the global environment imposed by socio-economic dynamics such as the increased amount of energy supply as a result of increased population and economic growth.

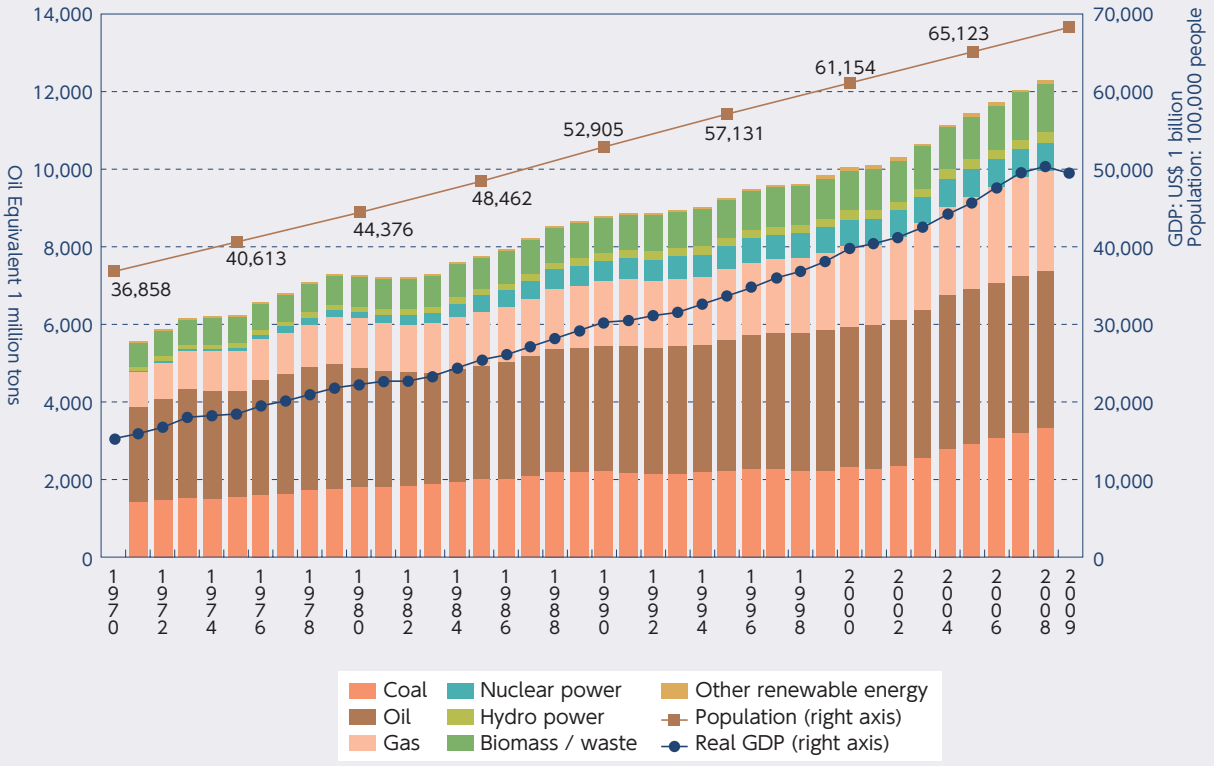
During the time period from 1971 until 2008, the world's energy supply increased by 2.2 times. Breakdown by energy source shows that the ratio of coal, oil, and

Figure 1-2-4 Ratio of Poor People Living on USD 1.25 or Less Per Day and Gini Coefficients of Each Country



Source: Created by the Ministry of the Environment, based on information from the World Bank's "PovcalNet" and the CIA's "The World Factbook 2009"

Figure 1-2-5 Trends in World Population, GDP, and Energy Supply



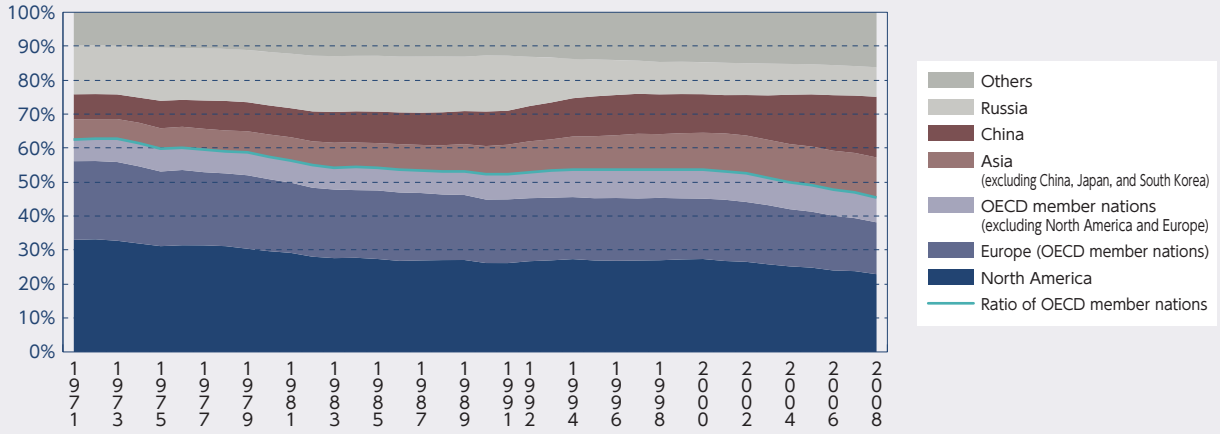
Source: Created by the Ministry of the Environment, based on information from the United Nations Population Division and the United Nations Statistics Division

natural gas combined has been 80% or more from the 1970s until today (Figure 1-2-5). There is also a trend of increasing energy supply in developing nations, mainly in Asia (Figure 1-2-6).

Based on these findings, it is likely that economic growth mainly in developing nations will continue, and the increase of energy demand and the trend to rely heavily on fossil fuels will continue. The population increase and economic growth thus far have led to the increase of energy consumption, and according to the IEA's predictions, if governments do not change their existing policies and measures, fossil fuels will continue to be the world's primary energy sources until 2030.

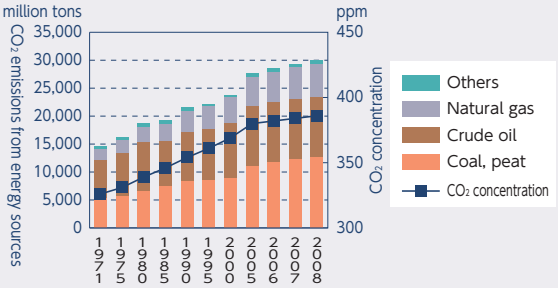
Now we will look at carbon dioxide (CO_2), which is a greenhouse gas that causes global warming. The emissions of carbon dioxide from energy sources are basically increasing in a consistent manner. The carbon dioxide emissions from energy sources approximately doubled from 1971 to 2008, increasing the CO_2 concentration level on the Earth as a result (Figure 1-2-7). According to the carbon dioxide distribution that the Japanese government estimates based on the world's measurement of carbon dioxide concentration, the global concentration of carbon dioxide in the atmosphere in 2009 was at the highest level in the history. By region, the annual average concentration is high in areas of high emissions, mainly in Europe, East Asia, and the eastern region of North America (Figure 1-2-8).

Figure 1-2-6 Trends in the World's Energy Supply (By Region)



Source: Created by the Ministry of the Environment, based on information from the IEA's "Energy Balances of OECD Countries 2010" and "Energy Balances of Non-OECD Countries 2010"

Figure 1-2-7 Trends in Concentrations of CO_2 in the Atmosphere and CO_2 Emissions from Energy Sources



Sources: CO_2 concentration: NOAA/ESRL and the US's Oak Ridge National Laboratory
CO_2 emissions from energy sources: IEA 2010 (CO_2 Emissions from Fuel Combustion 2010)

It is believed that this increase in CO_2 concentration is a factor of the increase in world temperature. Over the long term the world's annual average temperature has risen by a ratio of approximately 0.68 degrees centigrade per 100 years, and temperatures were high particularly in the late 1990s. In 2010, the world's temperature anomalies of the annual terrestrial and aquatic average surface temperatures, in other words, the average temperature minus the 30-year average from 1971 to 2000, was +0.34 degrees centigrade. This was the second highest value since observation started in 1891. Further, the average temperature in Japan in the summer of 2010 was the highest in the 113 years since observation started in 1898. We think this was caused not only by high atmospheric pressure and a cold air mass from the Sea of Okhotsk during that summer, the powerful high pressure from the Pacific Ocean which covered Japan after the rainy season, and effects from the El Nino phenomenon, but also by effects of global warming due to the increase of greenhouse gases such as carbon dioxide.

In this way, population increase and economic growth will lead to an increase of energy consumption in society and the economy, and the increase of carbon dioxide concentration caused by increase of energy consumption is a factor that places an environmental impact on the Earth in the form of global warming.

(2) Consumption of Biomass Energy and Loss of Forest Resources

Since long ago, forest resources have supported people's daily lives. They served as energy in the form of fuel wood, as well as timber for commercial logging.

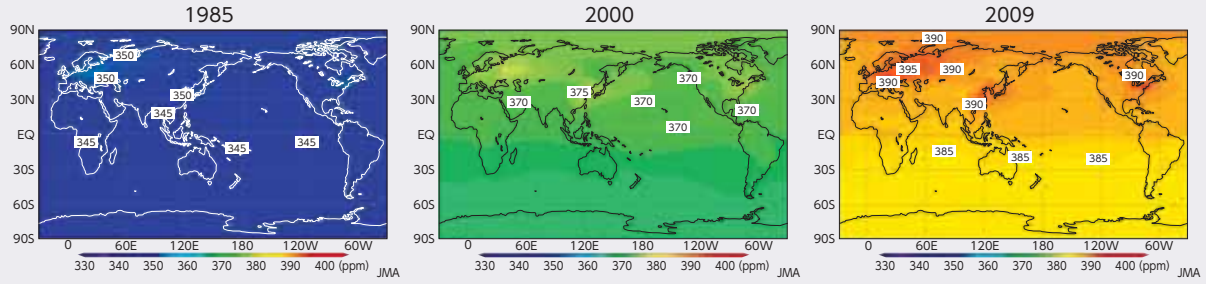
In recent years attention has been focused on the use of biomass resources as alternative energies to replace oil and other non-renewable resources. Around the world, there has been introduction of such resources, mostly bio-fuels obtained by refining plant-derived oil such as that from grains with high ratios of sugar and palm oil.

As for consumption of fuel wood and coal, a total of 3.4 billion m^3 of forest are cut down annually in the world, and approximately half of that is consumed as fuel wood. This logging amount is approximately the same as Japan's entire natural growing stock of forests of 1.8 billion m^3, and it places a significant impact on forest resources on a global scale. In particular, the ratio of use as fuel wood is high in Africa, Asia, and South America, where it makes up approximately 50 to 90 percent, as compared with Europe and North and Central America, where it makes up approximately 10 to 20 percent (Figure 1-2-10). Especially in Africa, due to poverty, forests are cut down excessively for fuel wood and to develop agricultural land.

As for the world's bio-ethanol production, 74 billion liters were produced in 2009, mainly in Brazil and the US, mainly from corn or sugarcane. As for bio-diesel, 15 billion liters are produced annually mainly in the EU, mostly from rapeseed. Production of oil palm, which is drawing attention as a source for bio-diesel, is increasing mainly in Malaysia and Indonesia. The land area for producing the palm trees that are used to manufacture palm oil has increased from 3.26 million ha in 1970 to 14.62 million ha in 2008, through conversion of tropical forests (Figure 1-2-11).

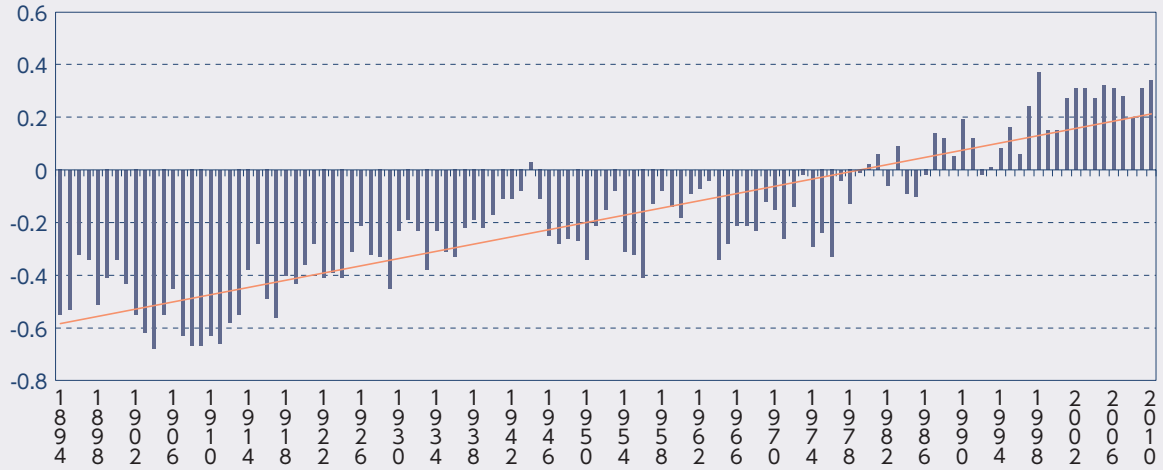
Additionally, with growing demand for food in recent years there is a trend of agricultural land area expanding and forest land area decreasing, primarily in tropical

Figure 1-2-8 Secular Changes in Carbon Dioxide Concentration Distribution



Note: "Information on Carbon Dioxide Distribution" is an estimation of the concentration distribution in various regions of the Earth by using a computer to process the data observed on the land and sea around the world.
Source: Japan Meteorological Agency's "Information on Carbon Dioxide Distribution"

Figure 1-2-9 Anomalies of Annual Average Temperature (degrees centigrade)

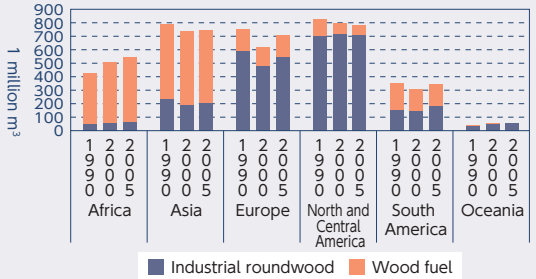


Source: Japan Meteorological Agency's "World Anomalies of Annual Average Temperature"

areas in Africa, South America, and Southeast Asia (Figure 1-2-12). While the amount of growing stock for forests (the total amount of volume of rough wood, including bark) steadily increased in North and Central America and Europe from 1990 until 2010, there is a trend of decline in growing stock for forests mainly in tropical areas, i.e., decreasing from 83 billion m^3 to 77 billion m^3 in Africa, decreasing from 191.5 billion m^3 to 177.2 billion m^3 in South America, and decreasing from 32.4 billion m^3 in 1990 to 29 billion m^3 in 2010 in Southeast Asia (Figure 1-2-13). Moreover, because the public statistical data do not reflect the illegal logging and other forest cutting that are not reported to public organizations, there are concerns that the actual amount of forests cut down may be higher than the figures publicly announced.

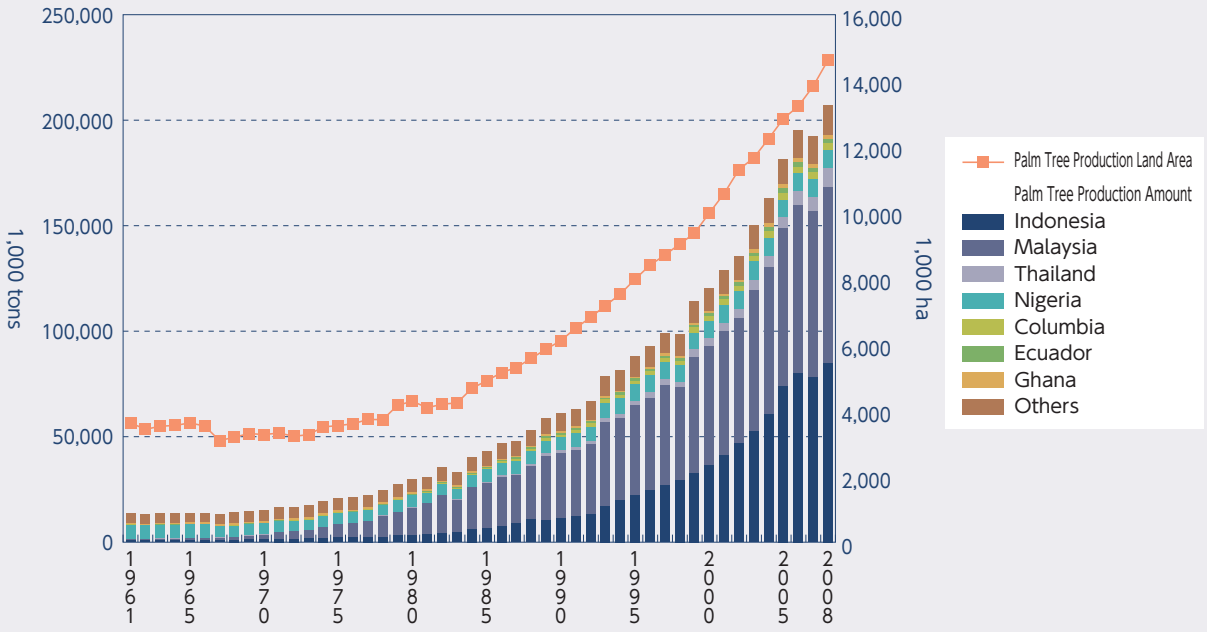
In the areas where a decline in these forest resources can be observed, it is necessary to strengthen governance in forest management that includes measures against poverty. In addition, as for bio-fuels such as bioethanol and bio-diesel, because there are concerns about competition with food if corn, sugarcane, and palm trees, etc. are used as the source, it is important to introduce waste biomass and unused biomass that will not compete with food. Technology developments in relation to this are necessary.

Figure 1-2-10 Trends in Wood removal (By Region)



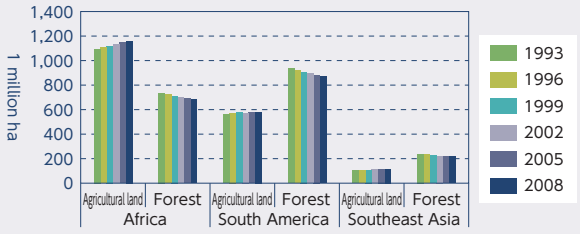
Source: Created by the Ministry of the Environment, based on the information from the FAO "*Global Forest Resources Assessment 2010*"

Figure 1-2-11 Trends in Amount of Production and Production Land Area of Palm Trees (World)



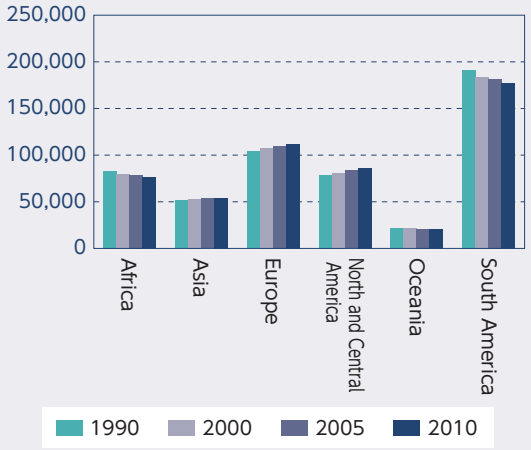
Source: Created by the Ministry of the Environment, based on the information from FAOSTAT (March 2011)

Figure 1-2-12 Trends in Forest Land Area and Agricultural Land Area (By Region)



Source: Created by the Ministry of the Environment, based on information from FAOSTAT (March 2011)

Figure 1-2-13 Trends in Amounts of Growing Stock for Forests (1 million m³)



Source: Created by the Ministry of the Environment, based on information from the FAO *"Global Forest Resources*

(3) Changes in Supply and Demand for Food, and Depletion of Water Resources

The dynamics of supply and demand for food, especially changes in dietary habits, is an example of the fact that economic growth may change the way resources are consumed and may increase the impact on the environment. It has been pointed out that along with economic growth there has been a change in dietary habits from plant-derived food such as grains to animal-derived food from livestock farming.

The amount of food production approximately doubled in the period from around 1970 until 2007, due to population growth and an increase of demand for food. This also led to expansion of the area of cultivated farm land. Since the beginning of the 1990s, that expansion of the area of farm land has stopped, but because the amount of grain harvested per unit area has increased, the amount of grain produced continues to increase (Figure 1-2-14).

The amount of calories supplied per person of the world population has increased from approximately 2,200kcal per person in 1961 to approximately 2,800kcal per person in 2007, and the status of nutrition supply for the world as a whole continues to be improved. However, the population of people around the world who suffer from malnutrition still remains at a high level. We have to note that there is a problem of unequal distribution of food.

As for the dynamics of calorie supply during this time period, although the ratio of calories supplied by animal-derived food slightly increased from 15.4% in 1961 to 17.2% in 2007, it is thought that overall the change is due to increased production of plant-derived food such as grains (Figure 1-2-15).

On the other hand, a different trend can be seen in the Asian region, which has shown remarkable economic growth in recent years. Asia's GDP made up approximately 17% of world GDP in the 1970s, but

in 2009 that ratio had risen to 28%. Looking at the dynamics of calories supplied in Asia during that time, while the total amount of calories supplied from around 1960 to 2007 increased by approximately 1.5 times, the ratio of calories supplied from animal-derived food rose from approximately 7% in 1970 to 15% in 2007. This trend is typical in East Asia, where the total amount of calories supplied has approximately doubled and the ratio of calories supplied by animal-derived food rose three times from 7% in 1970 to 21% in 2007 (Figure 1-2-16).

According to a report by the United Nations' World Water Assessment Programme and Plan (WWAP), in general, if livestock and grain are produced using the same amount of water, livestock is found more inefficient. Specifically, with 1 m^3 of water, the amount of wheat that can be produced is 0.2-1.2kg, while the amount of corn that can be produced is 0.3-2.0kg, and the amount of beef is 0.03-0.1kg. From now until 2050, it is expected that the demand for grain will increase due to growth in demand for grain for livestock, especially in East Asia, and there are concerns that this may lead to a shortage of water resources (Figure 1-2-17). In fact, there is a broad distribution of areas that suffer from a shortage of water resources, mainly in the west coast of South America, Africa, and Asia, where excessive use of water has led not only to water shortages that will seriously affect people's daily life, but also to a significant decrease of the water levels of lakes and other wetlands.

In summary, the dynamics of dietary habits associated with economic growth affect supply and demand of water resources and as a result may have adverse impacts on a broad range of areas in the environment, the economy, and society. In Japan, it is important to work to preserve water resources and water sources while keeping in mind the status of the world's water resources as mentioned above.

(4) Mining of Underground Resources, and the Environmental Impact

Underground resources such as mineral resources and fossil fuels are limited. The reserves/production ratio of resources is mostly less than 100 years, specifically, 70 years for iron ore, 20 years for lead, 35 years for copper, 20 years for gold, 15 years for chrome, and 46 years for oil (Figure 1-2-18). If the pace of production continues at its current speed, there is no doubt that the steady supply of underground resources for the current generation will become difficult, or worse, that we may not be able to leave resources for future generations.

In addition, underground resources generate a large amount of mine waste during processing. Some underground resources, even though their collection is technically feasible, may be found in a difficult location or the content rate may be low. In such cases, mining requires a large amount of energy and generates a large amount of waste, thus causing impacts on the environment. This is referred to as the hidden flow, and in order to verify sustainability related to underground resources it is important to also evaluate intermediate resources input for mining and the environmental impact caused by the amount of disposal.

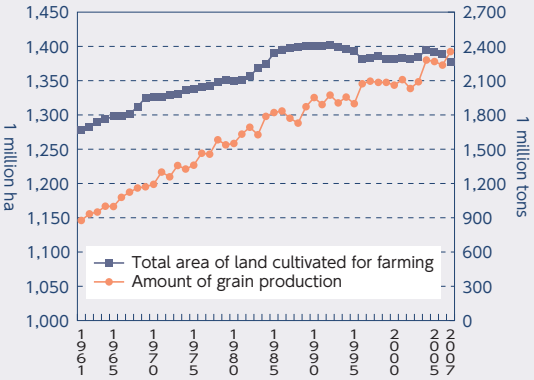
In Japan, although there has been improvement in energy and resource conservation thanks to technological progress, a large amount of limited resources still continue to be consumed. Consumption of such resources, especially fossil fuels that cannot be reused after being consumed, iron and copper that are consumed in enormous amounts due to human activities, and mineral resources that are very useful but also very scarce such as rare metals and rare earths, will have a significant impact on our future generations.

Here we will look at copper as an example of hidden flow. Copper plays an important role as a mineral resource that serves as a base for economic development; it is used as electrical wire and various copper-based alloy products in fields of transportation equipment and consumables such as construction, electric equipment, construction machinery, and automobiles. However, its regional distribution is remarkably uneven, and the top 10 mines produce 34% of the world's production. For example, among the 8 copper deposits that have reserves exceeding 10 million tons, 6 deposits are concentrated in Chile. From the perspective of securing stable copper resources, it is important to maintain the amount of production from these vast mines.

In general, the purity of crude ore obtained from mines is approximately 0.8-3% and even after it has been refined into a mineral concentration the purity is approximately 40%, and there are concerns that the quality of copper ore in the world's major currently operating mines is declining (Figure 1-2-19). The purity of copper ore imported by Japan declined from approximately 32% in 2001 to approximately 29% in 2008 (Figure 1-2-20). One of the reasons is that all of the high-quality mineral ore on the Earth's surface layer has already been dug up and now we have to dig to deeper layers where the quality of mineral ore is lower.

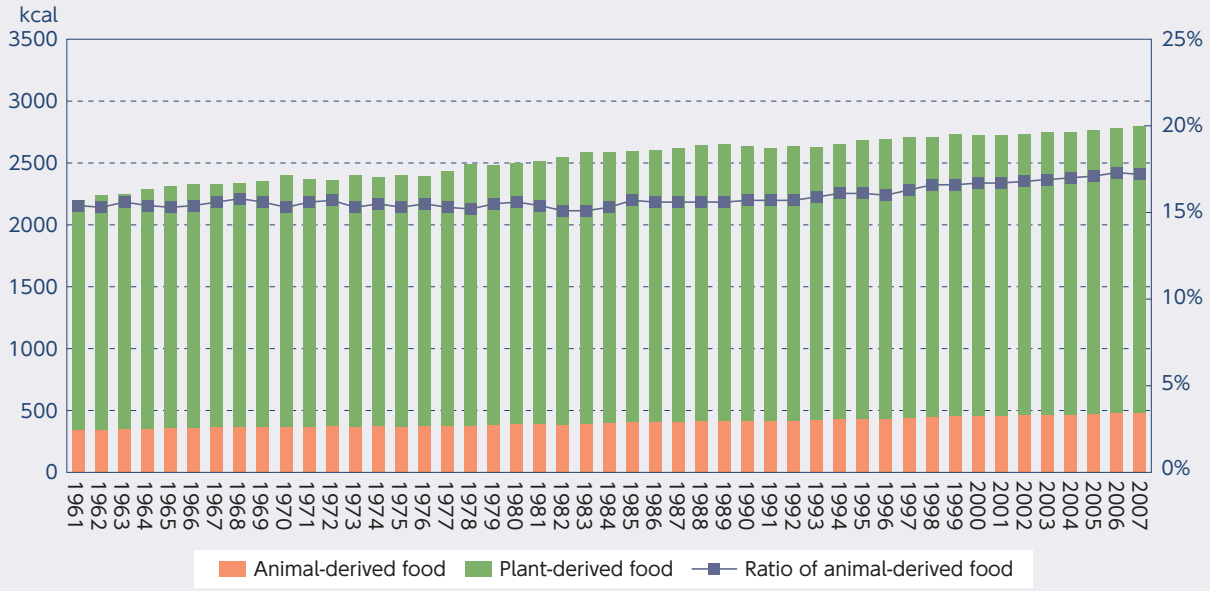
Because a decline in the quality of copper ore will lead to an increase in the volume of mine waste from processing of each unit of copper and the amount of energy required to refine the copper, it is also necessary to evaluate the environmental impact caused by mining mineral resources and consider the total material requirement (TMR), including such hidden flows. Trends in TMR show that the TMR value is increasing even though there have not been any major changes in copper

Figure 1-2-14 Trends in Area of Land Cultivated for Farming and Amount of Grain Production



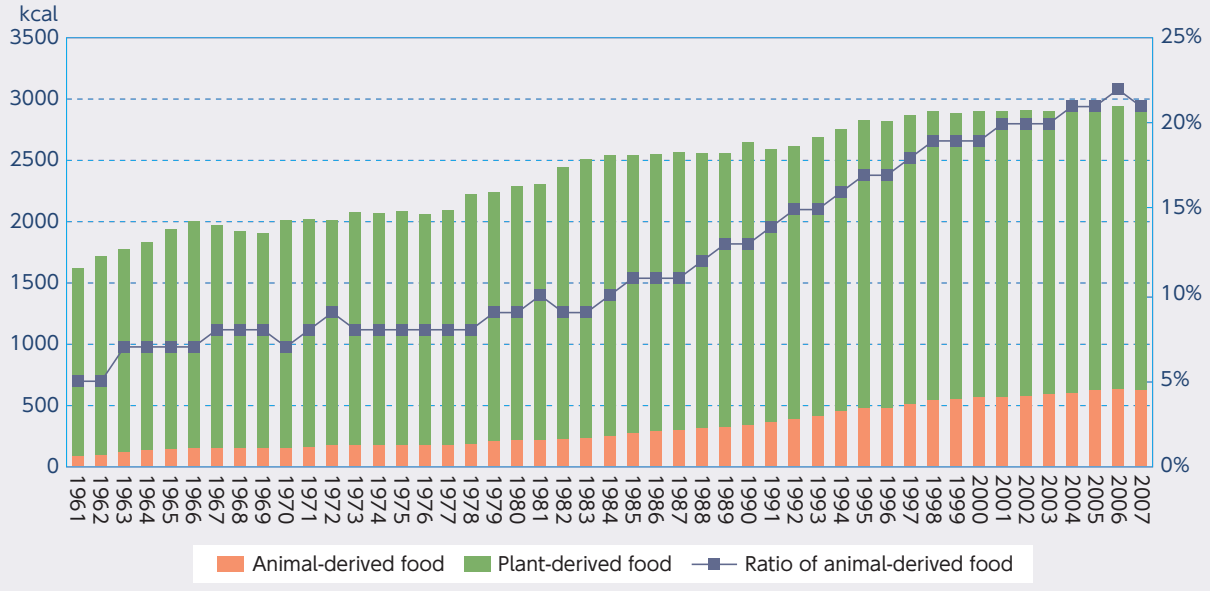
Source: Created by the Ministry of the Environment, based on information from FAOSTAT (as of March 2011)

Figure 1-2-15 Trends in the Amount of Calories Supplied Per Person of the Population (World)



Source: Created by the Ministry of the Environment, based on information from FAOSTAT (as of March 2011)

Figure 1-2-16 Trends in the Amount of Calories Supplied Per Person of the Population (East Asia)

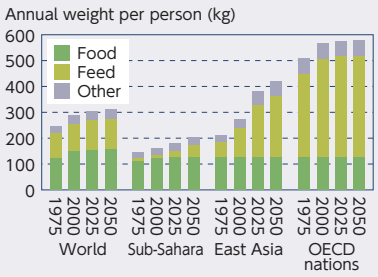


Source: Created by the Ministry of the Environment, based on information from FAOSTAT (as of March 2011)

Figure 1-2-17 Prediction of Demand for Grain and the Status of Water Resource Depletion

Product	Productivity per 1m³ of water	
	Kg/m³	Kcal/m³
Wheat	0.2～1.2	660～4000
Rice	0.15～1.6	500～2000
Corn	0.3～2.0	1000～7000
Beef	0.03～0.1	60～210

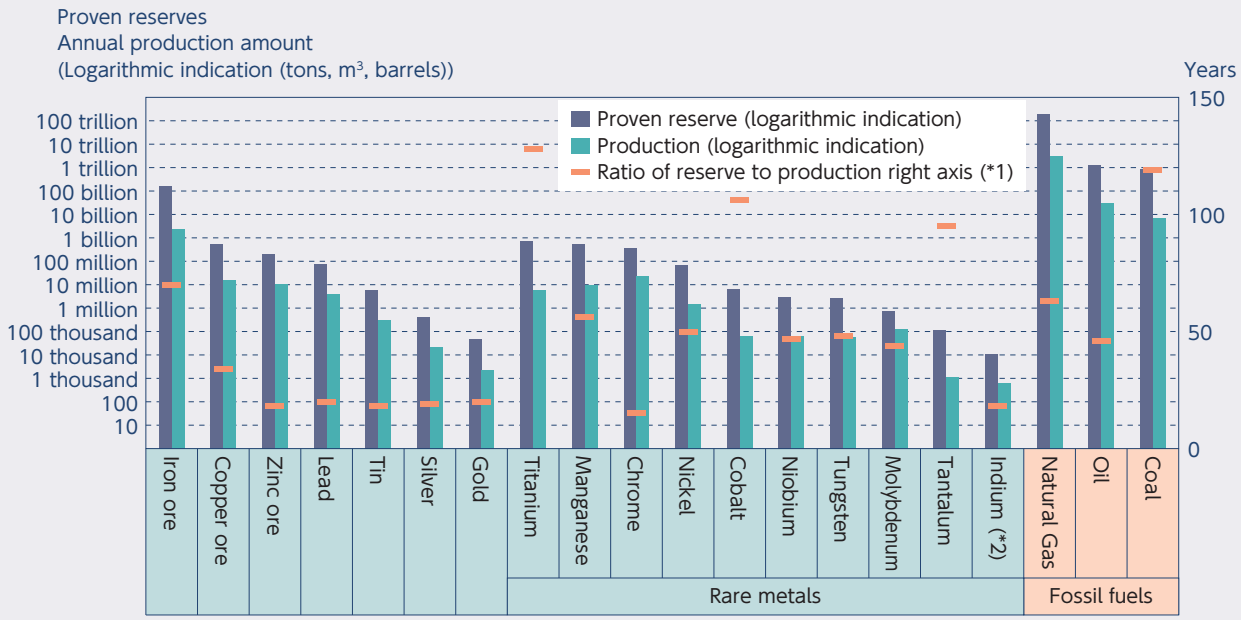
Predicted demand for grain



Status of exhaustion of water resources

Source: UN World Water Assessment Programme "*UN World Water Development Report, 2009*"

Figure 1-2-18 Proven Reserves and Annual Production Amounts (Left Axis, Logarithmic Indication) and Ratio of Reserves to Production (Right Axis) of the World's Main Underground Resources



Major item								Rare metals										Fossil fuels		
Item	Iron ore	Copper ore	Zinc ore	Lead	Tin	Silver	Gold	Titanium	Manganese	Chrome	Nickel	Cobalt	Niobium	Tungsten	Molybdenum	Tantalum	Indium (*2)	Natural gas	Oil	Coal
Ratio of reserves to production(*1)	70	35	18	20	18	19	20	128	56	15	50	106	47	48	44	95	18	63	46	119
Proven(mineral)reserves	160,000	540	200	79,000	5,600	400,000	47,000	730,000	540,000	350	71,000	6,600	2,900	2,800	8,700	110,000	11,000	187,490	1,333	826,000
Production	2,300	15.8	11	3,900	307	21,400	2,350	5,720	9,600	23	1,430	62	62	58	200	1,160	600	2,990	29	6,940
Unit	1 million tons	1 million tons	1 million tons	1 thousand tons	1 thousand tons	Tons	Tons	1 thousand tons	1 thousand tons	1 million tons	1 thousand tons	1 thousand tons	1 thousand tons	1 thousand tons	1 thousand tons	Tons	Tons	1 billion m³	1 billion barrels	1 million tons
Notes	Oxide	Oxide	Oxide	Net	Oxide	Net	Net	Oxide	Oxide	Net	Net	Net	Net	Net	Net	Net	Net			

(*1) The value for ratio of reserves to production is the amount of proven (mineral) reserves divided by the 2009 amount of production. The number of mineable years changes in relation to the confirmed reserves and the amount of production.
(*2) Only for indium, the proven (mineral) reserve is the 2007 value.
Source: Created by the Ministry of the Environment, based on information from the U.S. Geological Survey "Mineral Commodity Summaries 2010"

ore production in the world since 2001. There are concerns about the effects of the environmental impact caused by the decline in the quality of copper ore (Figure 1-2-21).

(5) Economic Development and the Environmental Impact

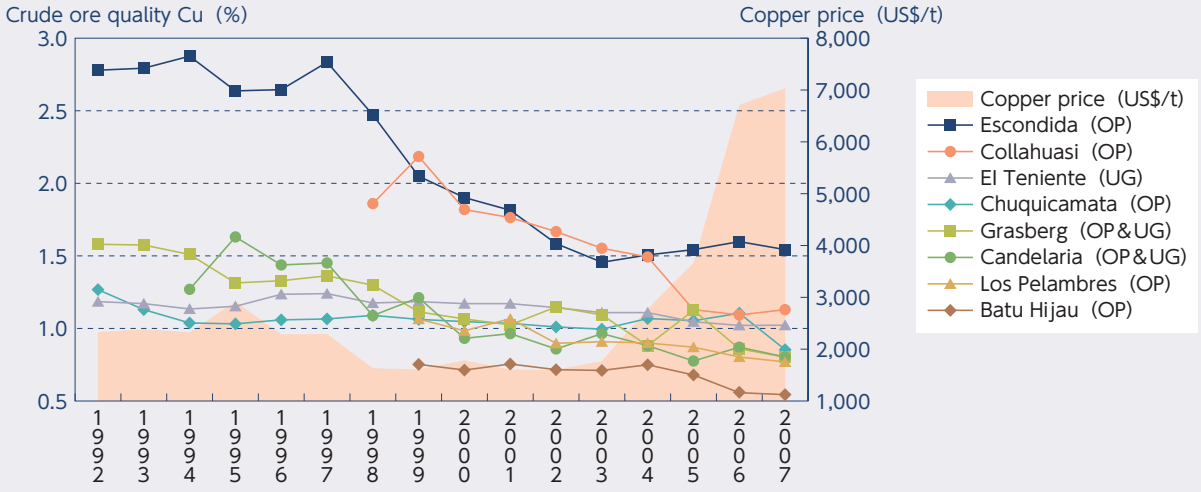
Thus far we have looked at individual human activities and the associated impacts placed on the environment. Lastly, in order to discuss a comprehensive relationship between human economic and social activities and their environmental impact, we now look at how economic development is related to the ecological footprint and the amount of CO_2 emissions.

In order for us to achieve sustainable development, it is important to decouple economic growth from the environmental impact, both of which have increased in parallel thus far. In other words, it is important to achieve decoupling, that is, to ensure that the rate of increase of environmental impact is lower than the rate of economic growth, and that economic growth does not cause environmental impacts.

There is a correlation between growth of the world's GDP and growth of the world's carbon dioxide emissions. As GDP increases, carbon dioxide emissions also increase (Figure 1-2-22). GDP growth and increase of carbon dioxide emissions indicates that relative decoupling is progressing, but absolute decoupling may not be.

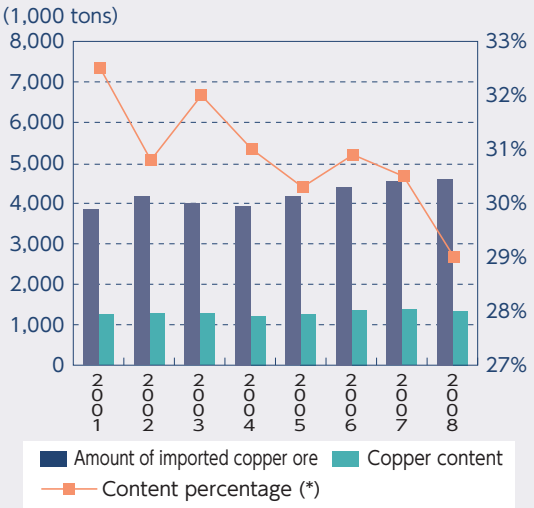
There is also a correlation between GDP and the values for ecological footprint that the WWF released in 2010 for approximately 140 countries in the world. Countries that have a high per-person GDP also have a high ecological footprint value (Figure 1-2-23). The ecological footprint is an indicator for comparison of people's amount of consumption of resources and nature's production capacity. It uses values indicated by converting the land area necessary for reproducing resources and purifying emissions, and it suggests that the world's economic growth still continues to cause impacts on nature's capacity to reproduce.

Figure 1-2-19 Trends in Crude Ore Quality and Price at Major Copper Mines



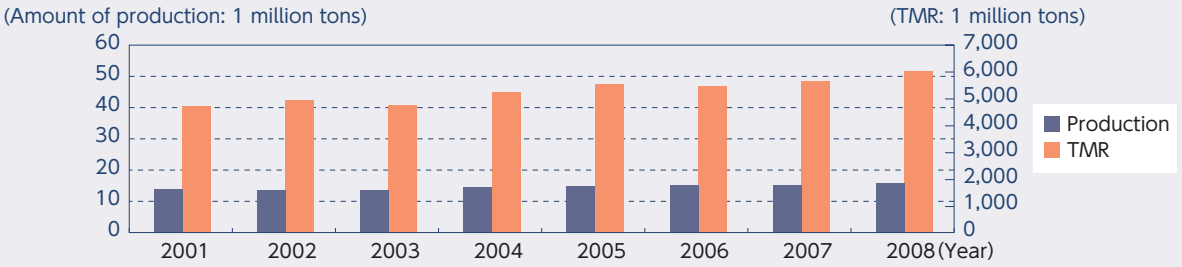
(Notes) OP: Open-pit mining UG: Underground mining
Source: JOGMEC Current Topics 2008, Issue 56, "Trend of Decline in Copper Quality"

Figure 1-2-20 Shifts in Content of Copper Ore Imported into Japan



(*) Content percentage = Copper content / Amount of imported copper ore
Source: Created by the Ministry of the Environment, based on information from "Statistics on Resources and Energy"

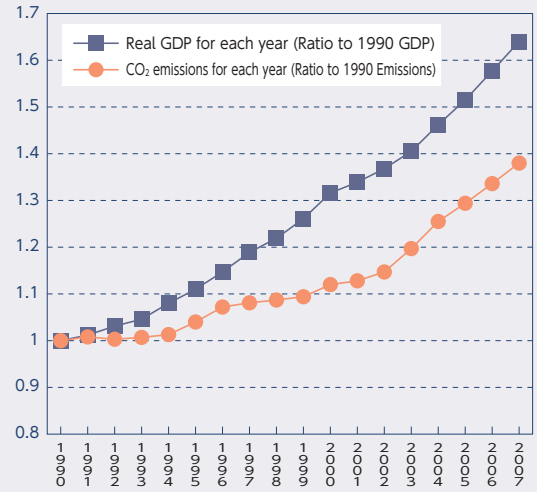
Figure 1-2-21 Trends in Amount of World Copper Production and Total Material Requirement (TMR)



	2001	2002	2003	2004	2005	2006	2007	2008
Amount of production (1 thousand tons)	13,700	13,600	13,600	14,600	15,000	15,100	15,400	15,700
TMR (1 million tons)	4,713	4,941	4,749	5,256	5,525	5,461	5,649	6,050
Estimated TMR coefficient	344	363	349	360	368	362	367	385

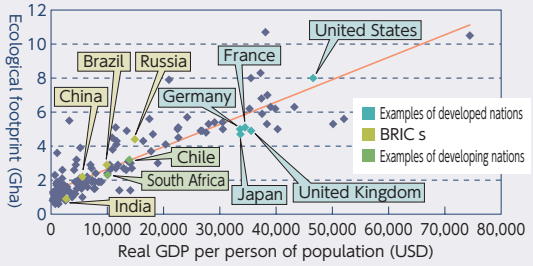
Source: Ministry of the Environment estimated figures considering the percentage of decline in quality of copper ore imported into Japan, based on 2004 TMR coefficients calculated by Komei Harada and others of the National Institute for Materials Science

Figure 1-2-22 Relative Decoupling of the Economy and the Amount of CO_2 Emissions



Source: Created by the Ministry of the Environment, based on information from the United Nations Statistics Division and the OECD Factbook

Figure 1-2-23 Relationship Between GDP Per Person and Ecological Footprint by Country



Source: Created by the Ministry of the Environment, based on information from IMF statistics and the Global Footprint Network

2. Japan's Sustainability and Quality of Life

As seen in the previous subsection, there are great concerns about sustainability, mainly about environmental sustainability.

Because Japan's socio-economic activities rely on both domestic natural resources and the world's natural resources, sustainability on a global scale may also affect Japan. Accordingly, what is the status of Japan's sustainability and quality of life?

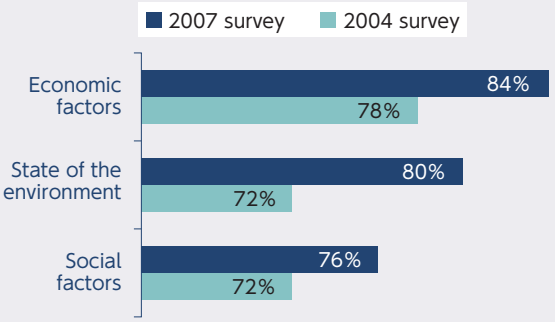
Quality of life and environmental sustainability are closely related. According to research that the EU released in 2008 in regard to factors affecting "quality of life," 84% of people in the EU say that economic factors have a large influence, and 80% of people say that the status of the environment affects quality of life (Figure 1-2-24).

There are a variety of issues for measuring quality of life, and various research and experiments are being carried out in Japan and in other countries. In the report by the Commission on the Measurement of Economic Performance and Social Progress (CMEPSP) that was mentioned in Section 1, quality of life is understood to have multiple factors, including physical living standard (income, consumption, wealth), health, education, and peace of mind and safety (physical and mental). In Japan, in addition to efforts made to calculate net national welfare (NNW), at present the Cabinet Office is conducting a study on the level of happiness, and further findings and observation are expected.

Here we will use the points of view suggested in the CMEPSP report as a clue to Japan's sustainability and quality of life, mainly in relation to environmental aspects. First, we will use several indexes related to environmental impacts and biodiversity in order to give an overview of Japan's sustainability, and then focus on environmental aspects, keeping in mind relationships with various factors.

Figure 1-2-24 EU Survey Results Concerning Quality of Life, Released in 2008 (Summary)

Question: In your opinion, to what degree do the following factors influence your "quality of life"?



Note: The choices of answers for this question were "Very much," "Quite a lot," "Not much," "Not at all," and "DK (Don't know)." The numbers shown in the figures above are sums of the ratios for "Very much" and "Quite a lot."

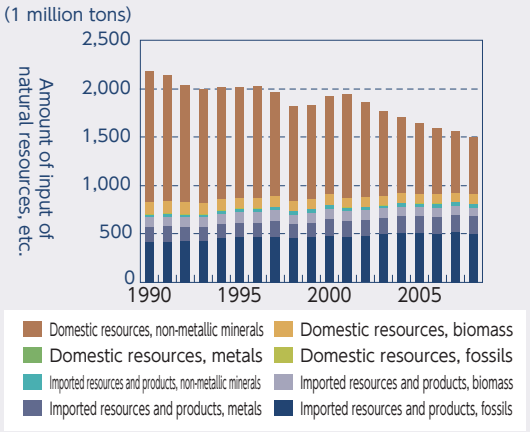
Source: The European Commission's "Special Eurobarometer 295"

(1) The Current status of Japan's Sustainability

What is the current status of sustainability in Japan? First, among the environmental impacts related to the sustainability problems for which there are global concerns, we will look at the status of greenhouse gases and consumption of natural resources. We will also take a look at the current overall condition of biodiversity, from the perspective of the stock of natural resources.

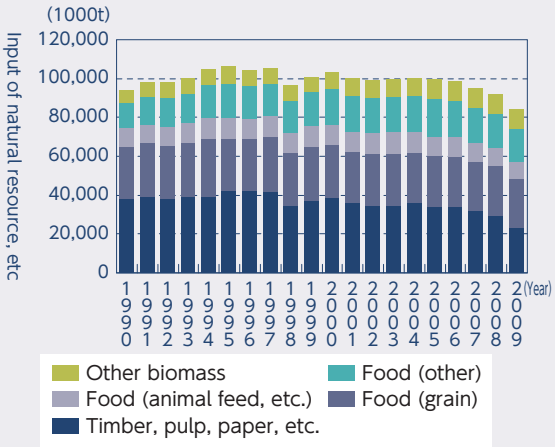
As the amount of input of domestic non-metallic mineral resources significantly declined, the amount of input of natural resources, etc. declined from approximately 2.2 billion tons in 1990 to 1.5 billion tons

Figure 1-2-25 Amount of Input of Domestic and Imported Natural Resources, Etc. by Type



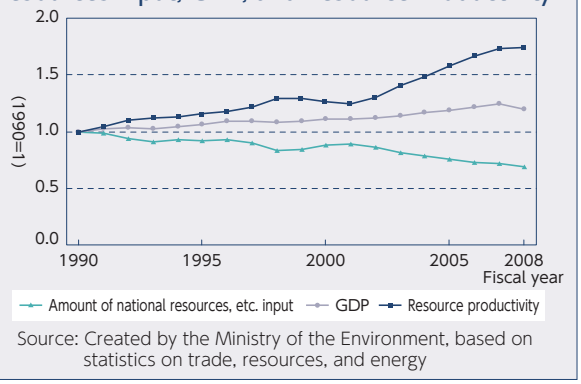
Source: Created by the Ministry of the Environment, based on statistics on trade, resources, and energy

Figure 1-2-26 Amount of Biomass Resources Input



Source: Created by the Ministry of the Environment, based on statistics on trade, resources, and energy

Figure 1-2-27 Trends in Amount of Natural Resources Input, GDP, and Resource Productivity



Source: Created by the Ministry of the Environment, based on statistics on trade, resources, and energy

in 2008 (Figure 1-2-25). In detail, although the amount of imports of fossil resources and products was gradually increasing, the amount of input of biomass resources such as timber (excluding waste) was decreasing (Figure 1-2-26). Japan's resource productivity (amount of resources input per unit GDP), which is an indicator that shows the level of efficient use of resources in people's daily lives and in industry, is increasing, and changes can be seen in the way that natural resources are consumed in Japan's society and economy (Figure 1-2-27).

Next, we will take a look at the emissions of greenhouse gases, using as an example the environmental impact associated with economic activities. The total emissions of greenhouse gases (final figure) in 2009 was 1.209 billion tons* (note: hereinafter the '*' indicates CO_2 equivalent). That was 4.1% less than the total emissions of 1.261 billion tons in the base year stipulated by the Kyoto Protocol (1990; however, HFCs, PFCs, and SF6 are based on 1995). Compared with the total emissions in 2008, there was a 5.7% reduction, as the emissions from the industrial and other sectors declined. One of the reasons behind the reduction in emissions from 2008 to 2009 is that in 2009 there was continuous decline in demand for energy in the industrial and other sectors due to the economic recession that followed the financial crisis that started in October 2008. (Figure 1-2-28).

Lastly, we will take a look at the status of biodiversity, from the perspective of Japan's stock of natural resources. According to the National Biodiversity Strategy 2010, which was approved by the Cabinet in March 2010, Japan's biodiversity now faces the "3 types of crises" discussed below and a "crisis due to global warming."

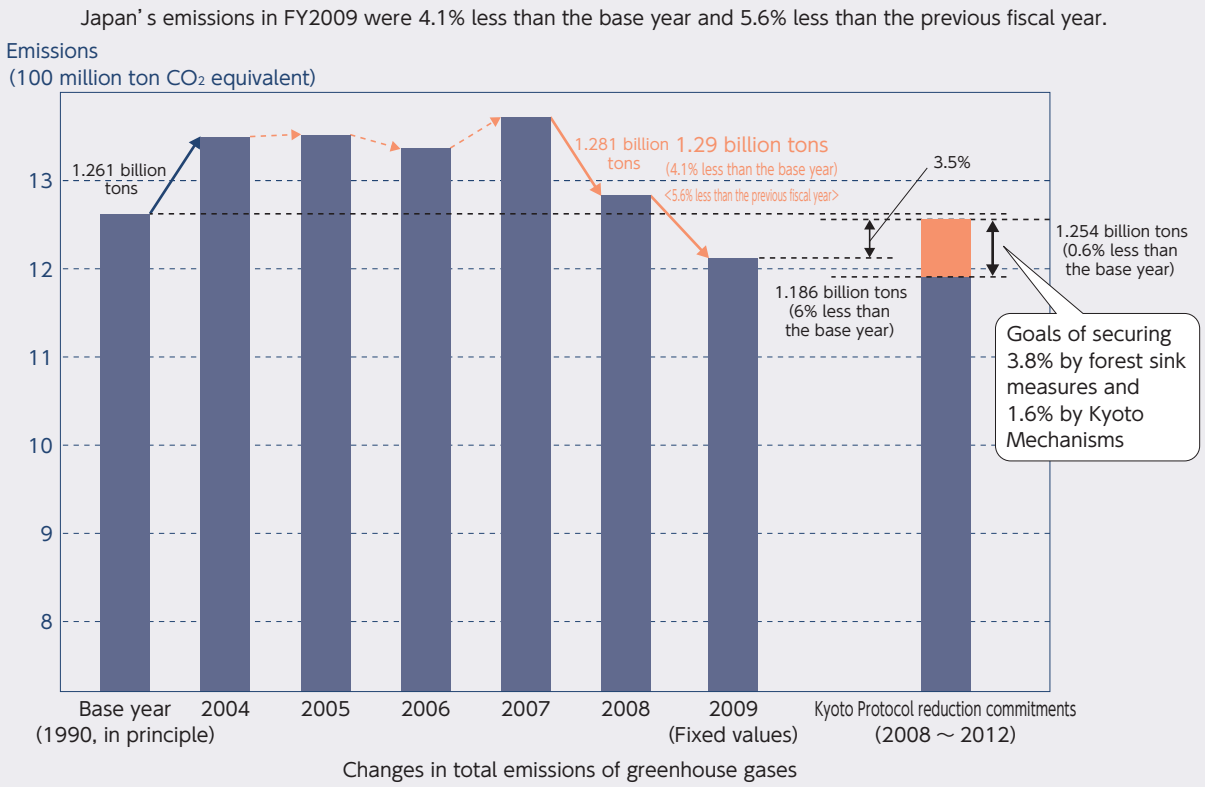
The first type of crisis (crisis caused by human activity and development) is environmental damage associated with the economic growth that Japan experienced after World War II, specifically in coastal and inland water areas where revetments were built along river banks and coastlines for developing industrial zones and implementing disaster prevention. For example, tidal flats, which made up 841 km^2 around 1945 right after the War, had decreased by 34% to 553 km^2 around 1978, and decreased to 496 km^2 around 1996. This means that compared with 1945, 41% of tidal flats had disappeared. Approximately 61% of wetlands such as inland water areas disappeared from 1900 to 1996 (Figure 1-2-29).

The second type of crisis (crisis due to lack of human activities) is changes in the quality of the environment and the status of wildlife's habitats, caused by the decline or withdrawal of human activities and involvement with nature, due to changes in lifestyles and industrial structures and socio-economic changes such as population decline. For example, the area of abandoned agricultural land increased by approximately 2.9 times from 1985 to 2005 (Figure 1-2-30). Many areas where interactions between humans and nature have been well maintained, represented by satochi-satoyama (community-based forest areas and the surrounding countryside), are now undergoing major environmental changes, with a reduction of cyclical use of natural resources through satoyama forests and secondary grasslands, due to population decline, aging populations, and industrial structure change.

The third type of crisis (a crisis caused by species brought in by humans) is the problem of alien species. In recent years aggressive invasive species are continuously being introduced and established in Japan's natural environment, and there is growing concern about their influence on Japan's indigenous ecosystem (Figure 1-2-31).

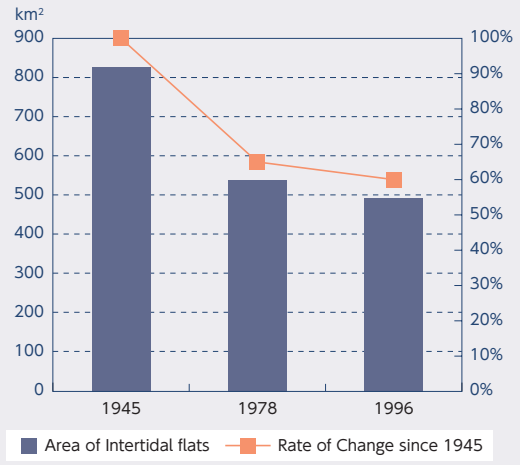
We have thus far made a cursory review of the current

Figure 1-2-28 Japan's Greenhouse Gas Emissions



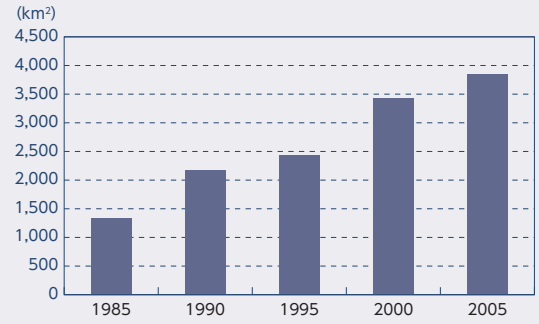
Source: Ministry of the Environment, press release materials

Figure 1-2-29 Trends in Area of Japan's Intertidal Flats (the First Crisis)



Source: Ministry of the Environment "National Survey on the Natural Environment"

Figure 1-2-30 Area of Abandoned Agricultural Land (the Second Crisis)



Abandoned agricultural land: Agricultural land that has not been cultivated in the last year or more and for which there is no cultivation plan for the coming years.
Source: Ministry of Agriculture, Forestry and Fisheries "Census of Agriculture and Forestry"

situation of Japan's environmental impact caused by socio-economic activities and the status of biodiversity. Although there is a trend of improvement such as the reduction of the use of natural resources, as a whole sustainability is a major concern. In order to be able to continue to enjoy a good quality of life in the future, it is necessary to preserve biodiversity, which is the foundation of our lives, and to reduce the impact on the environment.

(2) Environmental Quality as a Factor of Quality of Life

A pollution-free environment is the foundation for leading a healthy life, and a good environment with clean water, clean air, and abundant greenery enhances the quality of our lives. Measuring environmental quality will provide an indicator of the quality of life from an environmental perspective.

Many people demand a good environment without air pollution in order to enjoy healthy lives. The degree of

Figure 1-2-31 Invasive Alien Species in Rivers (1991-2005)

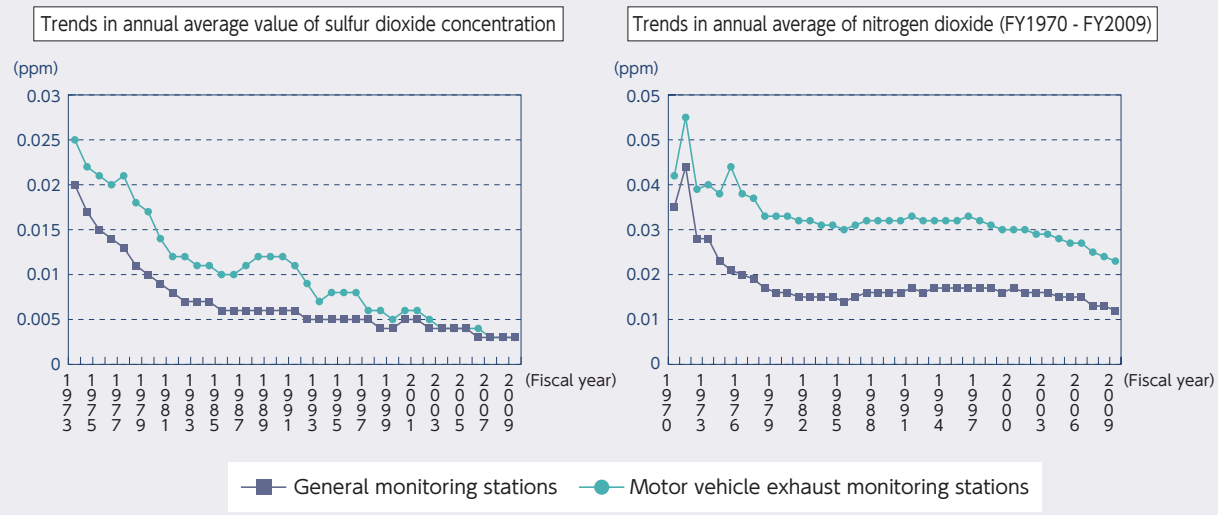
Source: OECD Third Environmental Performance Review: Japan (2010)

air pollution in Japan is heading toward improvement as the concentrations of sulfur dioxide, nitrogen dioxide, and nitrogen monoxide in the ambient air are declining (Figure 1-2-32).

Next, as for Japan's water quality, the nationwide achievement rate for Environmental Quality Standards for Water is 87%, which is relatively good. In particular, improvement of the water quality of rivers is making good progress, meeting 92% of the environmental standards. On the other hand, the achievement rate for environmental standards for inland lakes and reservoirs is low at 53%, which we suspect is due to a large volume of organic substances and an overabundance of nutrients in those inland lakes and reservoirs (Figure 1-2-33). As for the water quality of groundwater, it continues to have rates that exceed environmental standards for nitrate nitrogen and nitrite nitrogen (Figure 1-2-34). For that reason, we are reviewing measures to facilitate effective pollution prevention, reduce the pollution load, and increase use of purification technology in regions that have groundwater pollution from nitrate nitrogen.

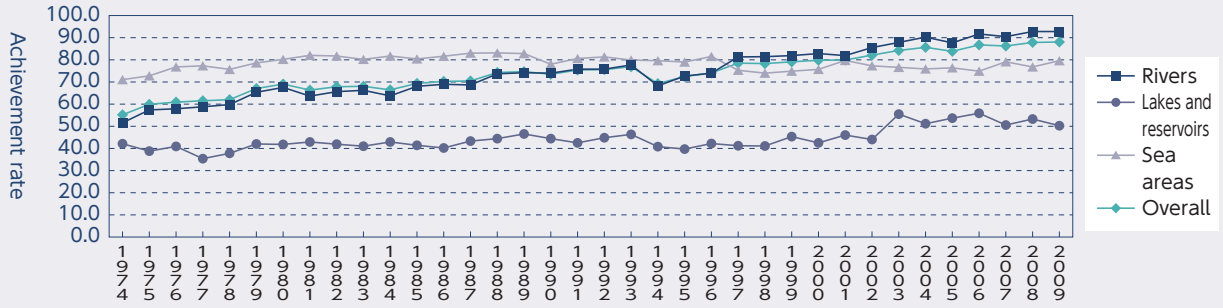
Now, we will look at the status of the green tracts (parks and forest) around us. The area of the nation's total area of city parks, which are the green spaces closest to people who live in urban areas, was approximately 116,667ha (98,568 parks) as of the end of 2009, which is an area of approximately 9.7 m^2 per person. The area of Japan's forests is around 25 million ha, which makes up two-thirds of the nation's entire land area. The amount of growing stock of forest, which indicates the volume of the main portion of trees in forests, more than doubled from 1966 to 2007, mainly through forest plantations, and thus forest resources are continuing to mature (Figures 1-2-35, 36, 37).

Figure 1-2-32 Trends in Concentration of Air Pollutants



Source: Ministry of the Environment, Environment Management Bureau, "The Status of Air Pollution in FY2009 (press release material)"

Figure 1-2-33 Trends toward Achieving EQSs (BOD or COD)



Note 1: BOD is used for rivers, and COD is used for lakes, reservoirs and sea areas.
Note 2: Achievement rate (%) = (Number of water areas that have achieved BOD/COD / Number of designated water areas) X 100
Source: Ministry of the Environment, Environment Management Bureau, Water Environment Division, "FY2009 Results of Measurement of Water Quality in Public Water Areas"

Thanks to these efforts and the relatively good status of the environment, people can find it easy to interact with nature, and they willingly come in contact with the environment. According to a survey on the current status of water quality of Class A rivers in Japan conducted by the Ministry of Land, Infrastructure, Transport and Tourism, more than 70% of the nation's Class A rivers were ranked as "a river that is easy to play in" according to the "indicator for future river management," which comprehensively evaluates the current status of a river environment from various perspectives (Figure 1-2-38). In addition, the Ministry of the Environment has been introducing organizations that conduct ecotourism around the country through a website called Ecotour Comprehensive since its 2005 launch. As of December 2010 the number of businesses registered was 728, which was 1.9 times as much as when it first started operating. The total number of registered ecotours was 2,603, which was 3.4 times as much as the number at the beginning. All these changes indicate that people are increasingly willing to become more familiar with the environment (Figure 1-2-39).

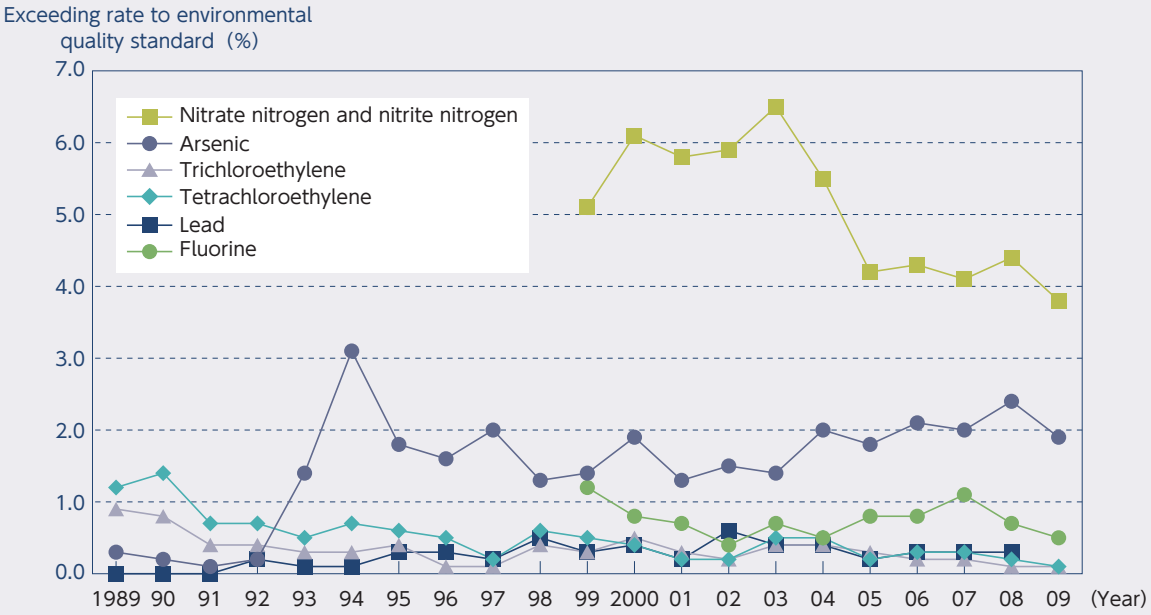
We have taken a look at several major aspects of the quality of the environment, and as a whole the status of the environment is relatively favorable or is continuously improving. These aspects are the foundation for leading healthy and good lives, and it is important to continue to work for further improvement.

(3) Status of Various Elements Related to Quality of Life and the Relationship with the Environment

Quality of life comprises of various elements related to the environment, the economy, and society. From those elements listed in the previously mentioned CMEPSP report, we will now focus on some of the leading indicators in aspects related to health, individual free activities (e.g. leisure), social connections, and material living standards such as consumption, and give an overview of Japan's sustainability and quality of life.

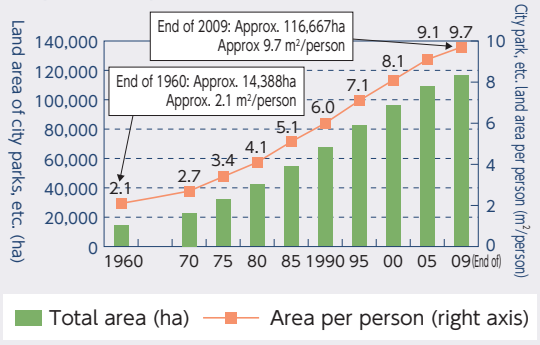
As for health, average life expectancy data shows that lifespan in Japan has continued to grow longer since the end of the World War II. Life-spans were around 65 years for men and around 70 years for women in the late 1950s and early 1960s, and they have extended to 79.59

Figure 1-2-34 Trends in Rate of Achieving Environmental Standards for Major Materials Related to Underground Water Pollution



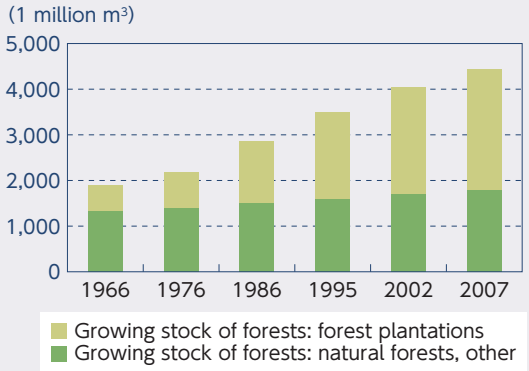
Notes: 1) The wells measured for the general survey differed by year (the same wells were not necessarily measured every year).
2) Environmental standards for underground water pollution were established in 1997. Standards before 1997 were used as evaluation standards. In 1993, the evaluation standard for arsenic was changed from "0.05mg/l or less" to "0.01mg/l or less," and the evaluation standard for lead was changed from "0.1mg/l or less" to "0.05mg/l or less."
3) Nitrate nitrogen and nitrite nitrogen, and fluorine were added to the environmental standards in 1999.
4) This graph only shows items for which the exceeding rate to environmental quality standard was relatively high.
Source: Ministry of the Environment, "FY2009 Underground Water Quality Measurement Results"

Figure 1-2-35 Trends in Land Area and Numbers of Japan's City Parks, Etc.



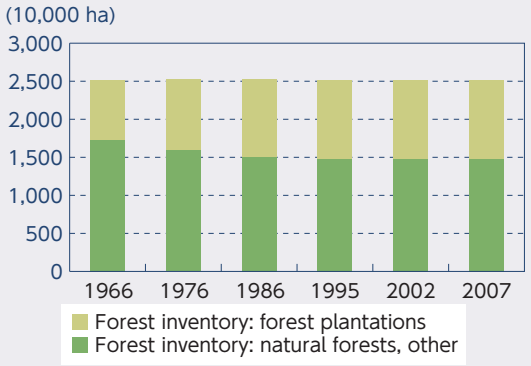
Source: Information from the Ministry of Land, Infrastructure, Transport and Tourism

Figure 1-2-36 Trends in Growing Stock of Forests



Source: Ministry of Agriculture, Forestry and Fisheries, The Status of Japan's Forests and Forest Management -The Second Country Report on the Montreal Process -

Figure 1-2-37 Trends in Extent of Forest and Other Wooded Land

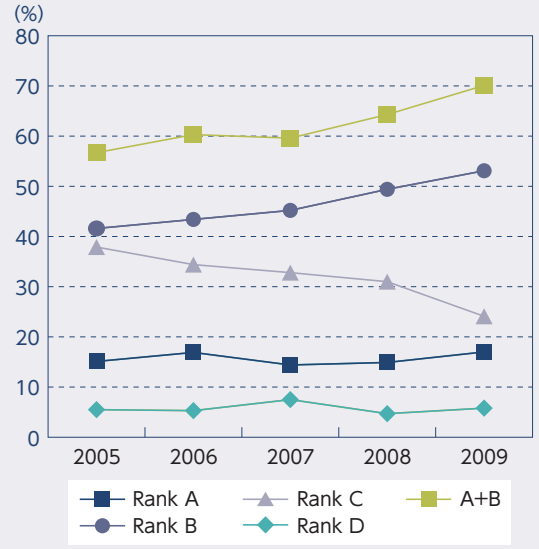


Source: Ministry of Agriculture, Forestry and Fisheries
The Status of Japan's Forests and Forest Management
-The Second Country Report on the Montreal Process -

years for men and 86.44 years for women as of 2009 (Figure 1-2-40). The ratio of people whose daily lives are affected by their health status increases with age, and among older people aged 65 or over the ratio was around 20% from 1995 to 2007.

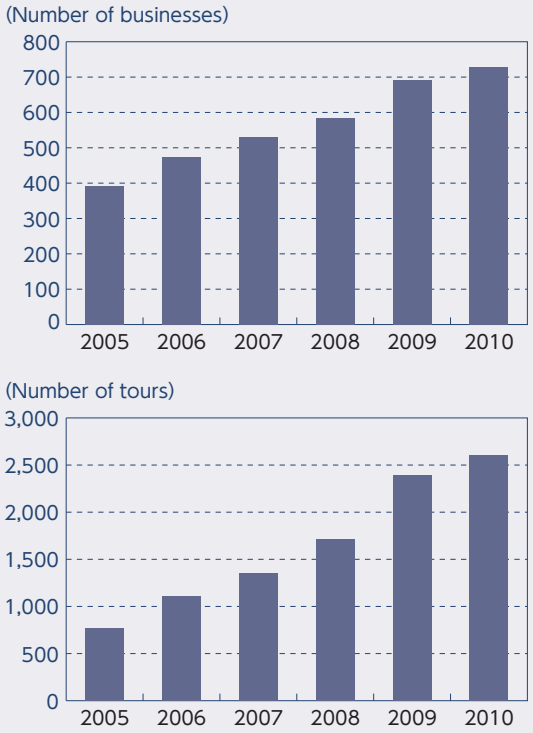
Furthermore, the ratio of people aged 85 or over whose daily lives are affected by their health status is around 40%, and now more than half of the people aged 85 or over can independently carry out their daily lives. Also, when we measure the relationship between GDP per person in a country and the life expectancy of the people in that country, there is a general trend that the life expectancy extends as GDP grows. On the other hand, in Japan average life expectancy extends even in a period where there is little or no growth in GDP (Figure

Figure 1-2-38 Trends of Indicators Related to Fulfilling Interactions with Rivers



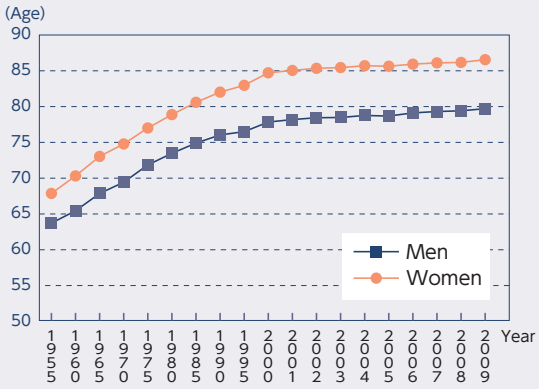
(Notes)
Rank A: It is easy to put one's face in the river's water (a clean river people would want to swim in).
Rank B: It is easy to play in the river.
Rank C: People would not want to go in the river, but it is possible to go near it.
Rank D: There is nothing appealing about the river, and it is difficult to go near it.
Source: Created by the Ministry of the Environment, based on information from the Ministry of Land, Infrastructure, Transport and Tourism's "Current status of Water Quality in the Nation's Class A Rivers (Indicators for Future Management of Water

Figure 1-2-39 Trends in the Number of Businesses Conducting Ecotours (Upper Graph) and the Number of Registered Tours



Source: Ministry of the Environment

Figure 1-2-40 Trends in Average Life-Spans of Men and Women in Japan



Source: Created by the Ministry of the Environment, based on information from the Ministry of Health, Labour and Welfare's FY2009 abridged life table

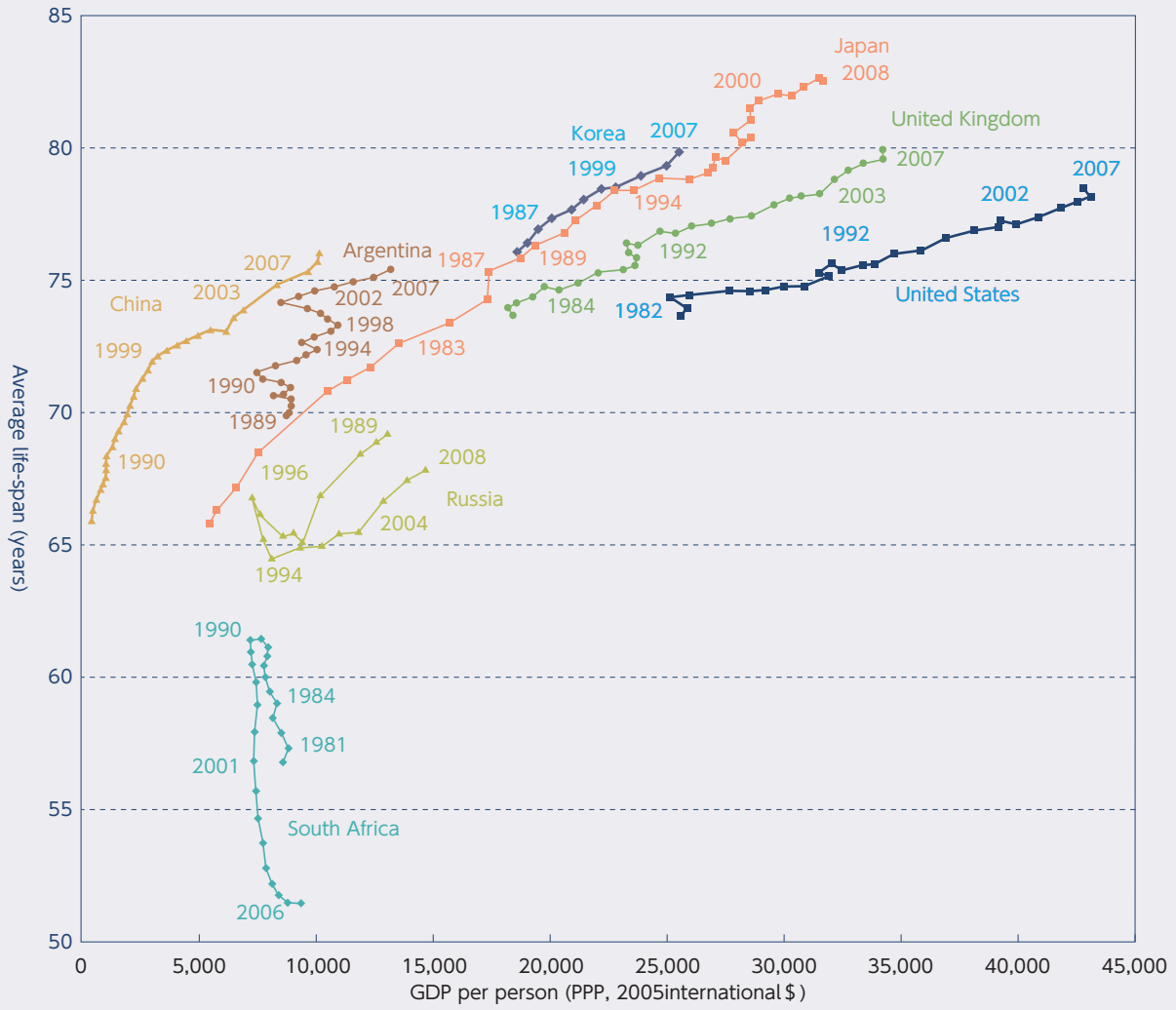
1-2-41), unlike other countries. From an international perspective, Japan has not only a long average life expectancy but also a long healthy life-span (the age at which a person can live independently and in good health). As for older people's awareness about health in Japan, many people consider themselves in good health, thus the people in Japan can have long life-spans and at the same time lead healthy lives.

Next, we will look at changes in the way people use their time in their daily lives. Since 1976, the number of working hours on weekdays remained around 8 hours and there have not been any major changes, but the number of working hours on Saturday and Sunday is declining. By contrast, the number of hours spent on leisure activities increased from 4.5 hours in 1976 to 5.7 hours in 2006 on Saturdays and from 6.3 hours to 6.8 hours on Sundays (Figure 1-2-42). As for the way that leisure time is spent, on weekdays older people have more leisure time than employed people, with employed people having 3.7 hours in FY2006, compared to 7.0 hours for older people aged 65 or older.

Now, we will take a look at the interaction of people and society. There is a trend that the level of people's interaction with neighbors declines with age (Figure 1-2-43). A survey conducted by the Cabinet Office concerning people's interaction with their communities showed that as many as 60% of people in Japan think that human relations have become difficult. As for the causes, 54% of people think that it is due to weakening of ties with communities, and more than 30% of people think that it is due to the trend of nuclear families and weakening of parent-child relationships (Figure 1-2-44).

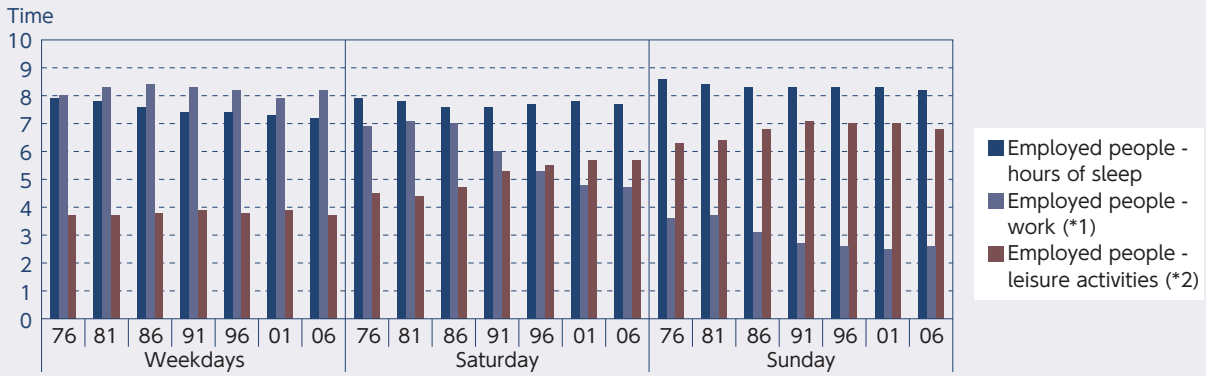
However, there is a trend that people seek personal relationships through activities to preserve the environment. People who participate in volunteer activities to protect nature or the environment have a high ratio of joining such activities through regional or school organizations or with family members, and this shows that such activities are being conducted through interaction between individuals, society, and families (Figure 1-2-45). In particular, among the people participating in volunteer activities with their family members, the ratio of protection of nature or the environment is higher than any other types of volunteer activities in terms of type of activities. In other words, preservation of the environment provides people with opportunities for family interaction (Figure 1-2-46).

Figure 1-2-41 Relationship Between GDP per Person and Life-Span in Each Country



Source: Created by the Ministry of the Environment, based on information from the World Bank's World Development Indicators 2010

Figure 1-2-42 Trends in Ways of Using Time in Daily Life (Sleep, Employment, Leisure)

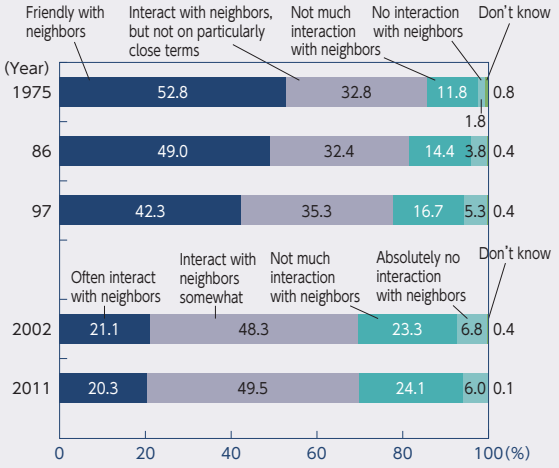


Source: Created by the Ministry of the Environment, based on information from the FY2006 survey on basic social life "Shifts in Overall Average Times by Gender, Usual Status of Employment, Day of the Week, and Type of Activity"
(*1) The total of time for work and commuting, taken from secondary activities
(*2) Excluding doctor visits, medical care, and other, taken from tertiary activities

There is also an increasing trend in the number of NPO groups that conduct activities to conserve the environment (Figure 1-2-47). People can feel their relationship to the community through their activities in the environment, because it is deeply connected to their own lives.

Looking at changes in household consumption expenditures, in recent years the consumption of durable goods

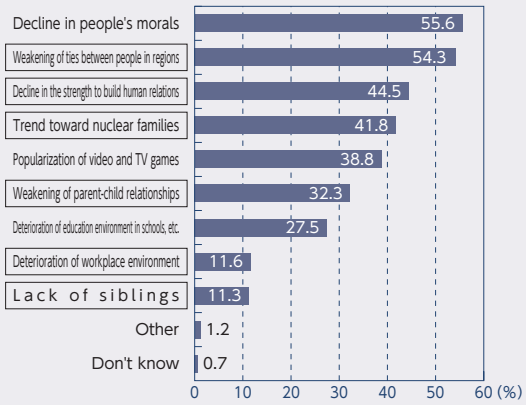
Figure 1-2-43 Trends in Degree of Neighborhood Interaction



(Notes) 1. Created by the Ministry of the Environment, based on information from the Cabinet Office's "Survey of Public Opinion on Social Awareness"
2. For 1975, 1986, and 1997, numbers are the ratio of people who answered the question, "How much do you interact with your neighbors? Please choose from these options."
3. For 2002 and 2011, numbers are the ratio of people who answered the question, "How much do you interact with people in your area? Please choose only one of the following answers."

Source: Created by the Ministry of the Environment, based on information from the Cabinet Office's "Survey of Public Opinion on Social Awareness"

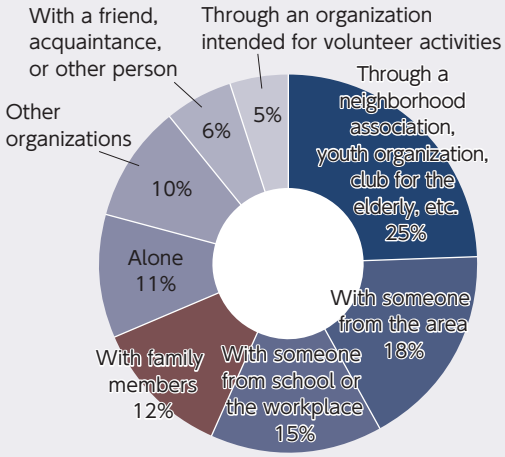
Figure 1-2-44 Reasons Why Human Relations Have Become Difficult



(Notes) 1. Created from the Cabinet Office's "Special Survey of Public Opinion on Safety and Peace of Mind" (2004)
2. The survey asked people who had answered the question "In general, what do you think about the status of "human relations" recently? Please choose only one of the following answers" by circling "They've become difficult" or "They've become somewhat difficult" to answer the question "What do you think are the causes for this? Please choose as many of the following answers as you like."
3. The respondents were 1,364 people aged 20 or older from all over Japan.

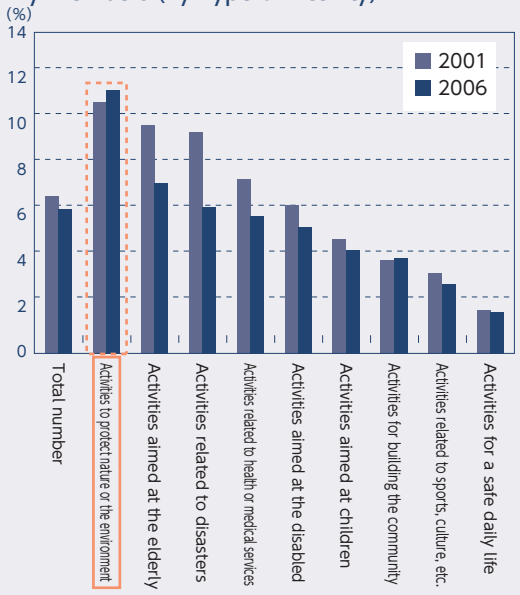
Source: Cabinet Office's FY2007 White Paper on Citizens' Lifestyles

Figure 1-2-45 Volunteer Activities for Protecting Nature and the Environment (By Activity Type)



Source: Created by the Ministry of the Environment, based on information from the Ministry of Internal Affairs and Communications' Fundamental Survey on Social Life (FY2006)

Figure 1-2-46 Ratios of People Who Volunteer with Family Members (By Type of Activity)



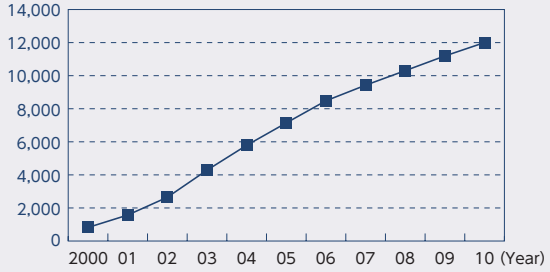
Source: Created by the Ministry of the Environment, based on information from the Ministry of Internal Affairs and Communications' Fundamental Survey on Social Life (FY2006, FY2001)

such as household appliances and automobiles peaked in the 1990s and has been in a trend of consistent decline ever since, having declined to approximately 15% as of 2010. Consumption of non-durables such as food and consumables has been declining consistently since the 1980s, and at present has fallen to approximately 25%. On the other hand, consumption of services such as medical care, education, communications, and transport surpassed 50% around 1990, and as of 2010 its ratio had climbed to nearly 60%. In summary, in order to achieve a good quality of life, the consumption of services has become more important than the consumption of materials (Figure 1-2-48).

Based on such social and economic elements and environmental elements, what is the status of Japan's quality of life as a whole? In an attempt to answer such a question, we will now look at the results of the National Survey on Lifestyle Preferences, in relation to one of the questions, "How happy are you?" This was a question that people were asked to answer on a scale of 1-10, and the trend in Japan is that the most-chosen answers were 5, and 7 or 8.

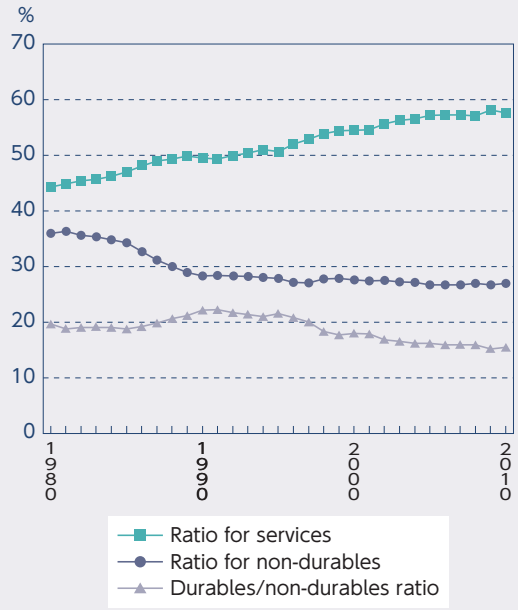
This trend observed in Japan is quite different from Great Britain's and Denmark's results for a social survey conducted in Europe, for which most people chose 8. This

Figure 1-2-47 Shifts in the Number of Specified Non-Profit Corporations that Carry Out Activities to Preserve the Environment



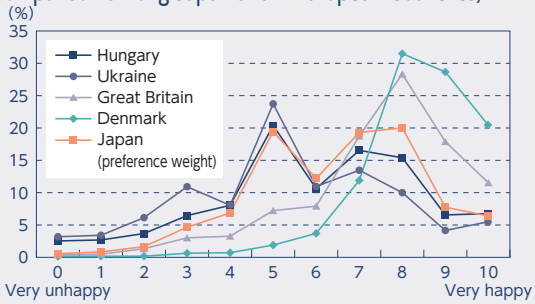
Source: Cabinet Office: Number of applications received and number of certifications granted based on the Law to Promote Specified Nonprofit Activities

Figure 1-2-48 Shifts in Ratios of Households Consumption Expenditures



Source: Created by the Ministry of the Environment, based on information from the Cabinet Office's "National Economic

Figure 1-2-49 Ten-Level Evaluation of "How Happy are You?" (Comparison among Japan and 4 European Countries)



Source: Information on Japan was taken from a survey on national characteristics and preferences, and information on the four European countries was taken from a European social survey.

indicates that in Japan many people do not feel a great deal of happiness (Figure 1-2-49).

Now let's think about the meanings of these various elements and overall trends discussed here, particularly in regard to the current necessity of reducing the impacts on the environment.

First, the trend of increasing consumption of services and reduction of amount of input natural resources suggests that it may be possible to improve quality of life through development of service consumption without increasing the environmental impact caused by consumption of natural resources and energy.

Second, while the connections between people and society are weakening, the trend of rising volunteer activities to protect nature and the environment will serve as a foothold for improving the environment. The longer life-spans and increased leisure hours also suggest that this will become an increasingly important perspective in the future.

In addition, establishing a safe society in which people can live safely and securely is one of the most fundamental elements required to achieve a good and sustainable society. For example, environmental problems and natural disasters are closely related. Rising sea levels and meteorological disasters caused by climate change, and declines in the water-retaining functions of forests and flooding caused by excessive logging of forests are examples of environmental deterioration that further worsen the damage from natural disasters. On the other hand, a large-scale natural disaster not only breaks down the foundation of our lives and production, but also leads to environmental problems such as generation of huge volumes of waste.

For this reason, it is important to promote the prevention of natural disasters and preservation of a good environment in normal times, and when natural disasters do occur, it is important to take immediate actions to deal with environmental issues such as disaster waste to facilitate efforts for recovery.

In comparison to a perspective that emphasizes only the scale of economic activities and material living standards, reviewing the elements of quality of life in depth will open up the possibility for simultaneous improvement of both sustainability for the future and current quality of life. Further efforts aimed at evaluating and measuring sustainability and quality of life will be necessary, and it is important for each of us as individuals to think deeply about what true quality of life is.

Conclusions

In Chapter 1 we have looked mainly at sustainability and quality of life in our daily lives, based on various data that is related to such things. We have to achieve a sustainable society and pass on to the next generation the quality of life that the current generation enjoys. We believe it is necessary for us to promote sustainable use without exhausting all of the natural resources, and to keep a healthy environment without excessive environmental impacts on the Earth, because natural resources support our lives and the Earth is the foundation of our survival.

In order to achieve sustainability and good quality of

life, it is necessary to gather various forms of knowledge, including traditional wisdom and new science and technology, and establish not only domestic rules but also international rules and turn them into reliable actions.

For further consideration of environmental aspects in relation to this issue, in Chapter 2 we will review knowledge for sustainable use of ecosystem services, which are the Earth's benefits. In Chapter 3 we will discuss biodiversity, which is the basis of such ecosystem services, and make proposals about the necessity of rules and actions in order for humans, nature, and the Earth to coexist. In particular, we will focus mainly on the 10th Conference of the Parties to the Convention on Biological Diversity. In Chapter 4 we will focus on actions to contribute to the world's green growth through Japan's technologies, and to improve global sustainability, particularly a material-cycle society and a low-carbon society.

In this report, we added Chapter 5 and discussed in "Toward Recovery from the Great East Japan Earthquake" the massive magnitude 9.0 earthquake that was centered off the Sanriku coast.