Background to the abridged English-language version of *How Should We Adapt Climate Change Risks: Smart Adaptation for Businesses, Governments, and Grassroots Organizations*

The Environmental Issue Research Group, launched in 1993 by Sompo Japan Nipponkoa Insurance Inc. (former Yasuda Fire & Marine Insurance Company), has until now treated three topics—soil pollution, waste, and the precautionary principle—with a timely assessment of related social issues and potential solutions, and shared the research results with the world in the form of a book publication.

As our research topic for the period from May 2011 through December 2013, we chose "Climate Change: Adapting to Natural Disaster Risk."

As efforts to address global environmental issues through "mitigation" move forward, there is a likewise growing interest in and call for action on "adaptation" to climate change. We chose this topic of adaptation because it strongly linked to the property and casualty insurance business.

In February 2014, just ahead of the March 2014 IPCC meeting in Yokohama, Japan, we presented the results of this research with the release of a book entitled *Preparing for Climate Change Risk: Smart Adaptation for Businesses, Governments, and Grassroots Organizations.*

The present publication is an abridged English translation of the book, prepared for all stakeholders including overseas businesses who want to learn more about this pressing topic. We hope you will make the most of this valuable information.

Sompo Japan Nipponkoa Environmental Foundation
March 2015

Preface

Shuzo Nishioka
Institute for Global Environmental Strategies

1. Climate Change as Certainty

Recent measurements show that the earth's average surface temperature is rising at an accelerating rate. If this rate continues, the resulting change in daily weather patterns will most certainly have a major impact on everything from water resources and disaster preparedness to natural ecosystems and food production.

Both natural and human systems can tolerate a certain amount of change. Terrestrial and marine communities of plants and animals can, to a certain extent, adjust to rising temperatures and consequential changes in the weather environment. And if the change is significant, they can adapt by changing themselves. Human societies can also adjust, by turning on the air conditioning during a heat wave, or by fortifying protective infrastructure in the case of disasters caused by windstorms and floods. Such modifications to natural and human systems made in response to current or projected climate changes and their impacts, with the intention of minimizing adverse impacts or capitalizing on emerging opportunities, are what we call climate change adaptation.

Regardless of the causes of our changing climate, there are limits to our adaptive capacity, which means that we must work to eventually stabilize it. If climate change is a natural one, biological and human communities have no choice but to surrender and do everything in their power to adapt. However, if the current climate change is caused by anthropogenic factors, we can survive by controlling those factors and stabilizing climate within the range of our ability to adapt.

The Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), published in 2013, states that present climate change is "extremely likely" due to anthropogenic increase in greenhouse gas (GHG) concentrations. This means that mitigation of climate change through anthropogenic control is possible. If we can adequately mitigate climate change by reducing GHG emissions, natural and human communities will be able to survive on less adaptive effort.

The global mission of stabilizing climate by reducing GHG emissions is being driven by the United Nations Framework Convention on Climate Change (UNFCCC). The prospect of stabilizing climate looks bleak within the current agreement, set by the Kyoto Protocol, wherein only some industrialized nations have committed to reducing their GHG emissions. For this reason, the UNFCCC is advancing negotiations to create by 2015 an international framework in which all parties will participate in reducing emissions starting in 2020.

The current consensus is that by 2050, total global emissions of carbon dioxide need to be reduced to half their current level (30 billion tons per year) in order to stabilize climate and limit global temperature rise to 2 degrees Celsius above pre-industrial levels, the level targeted by the UNFCCC, G8, and others in the international community. To do that, the world's nations need to reduce by 2030 at least 8 billion tons *on top of* the amounts they have committed to reducing under the 2010 Copenhagen Accord.

But international negotiations on GHG emissions reduction are moving far too slowly. Many are coming to the realization that the 2-degree target can't be met at the current rate. An increasing number of experts, anticipating a potential rise in average surface temperatures of 3 or 4 degrees Celsius by the end of the century, are advocating the need to promote adaptation.

2. Toward an Integrated Policy of Mitigation and Adaptation

As action on climate change mitigation falls behind amidst reports of deepening climate change and associated damages, adaptation is climbing on the climate policy agenda. Faced with the inevitability of climate change, communities the world over are taking steps to prepare. As a result, climate policy is moving toward making maximum mitigation efforts in tandem, or synergistically, with preparation for worst-case scenarios.

While the need to consider adaptation when assessing the impacts of climate change was indicated as far back as the 1990s, when climate change was beginning to draw public attention, policy research on adaptation and mitigation were carried out separately, with the majority of research focused on predicting the size of impacts and the level of mitigation that would be possible. Starting in the 2000s, however, when awareness of the difficulty of implementing mitigation began spreading and various phenomena attributable to climate change began to be observed around the world, it became clear that waiting for mitigation measures to stabilize climate proved too risky: adaptation was unavoidable.

While the impacts stemming from climate change are manifold, in the near term we can expect temperature and rainfall patterns to fluctuate to greater extremes, heat waves, rainstorms, droughts and other extreme weather events to happen more frequently, and weather disasters to grow in intensity. Over the long term, sea levels will rise—continuously and inexorably. To respond to this, the adaptation perspective must be incorporated into existing plans regarding land use, disaster preparedness, and infrastructural investment (i.e., mainstreaming of climate change policy). Doing so will make nations more resilient to disasters resulting from natural hazards.

Adaptation is increasingly becoming the focus of research and institutional programs, and is beginning to garner attention in international negotiations. It has also become clear that mitigation policies that address energy supply alone are inadequate, and that they must also include within their scope land use and urban infrastructure development. We have entered an age when climate policy must integrate mitigation with adaptation.

3. Practical Challenges to Adaptation

Specific measures for implementing adaptation exist as an extension of efforts already being made in various sectors and fields. For example, as temperature and rainfall patterns change, more dams will be needed to store water for emergencies and natural hazards such as droughts and floods. To maintain crop yields amidst a changing climate, farmers will have to shift planting seasons, or plant different varieties of crops. There is very little that humans can do to counteract the widespread ecological change and species loss that will take place on a global scale. We can only leave it up to

nature and see if ecosystems move toward the poles or evolve new forms of life.

Adaptation measures must be constructed in consideration of the following characteristics of climate change problems.

I. Irreversibility
Impacts, once set in motion, will have an inertia all their own. Even if climate is restored, the changes will not reverse. There is also no guarantee that climate can be restored. Precautionary measures that preempt changes are essential.

II. Prolonged impacts
The impacts of warming will transpire on a time scale of hundreds of years. For example, the Antarctic and Greenland ice sheets will not melt immediately as temperatures rise but gradually, following the general temperature trend, causing sea levels to rise over centuries. In contrast, extreme weather events, characterized by severe fluctuations in temperature, rainfall, and the like, will emerge rather quickly.

III. Uncertainty
Climate modeling research has advanced to the point where scientists have not only obtained consistent findings on regional and spatial climate change patterns, but can also, using advanced computing capabilities paired with downscaling methods, calculate climate changes with a high degree of resolution.

However, while it is safe to say that the major trends of climate change are already understood, we are still unable to adequately predict where, when, what, and the degree to which changes will occur. Moreover, projections of global average temperature rise vary greatly depending on the model researchers use, to say nothing of the fact that the rate of increase also depends on how much GHG emissions are reduced going forward. Consequently, it is still difficult to develop adequate adaptation measures for a given region based on the results of only a single model.

Adaptation strategies need to take these uncertainties into account and be considered from a broad, flexible perspective.

IV. Site-specificity and variability
While the impacts of climate change are global, the nature of climate (weather) changes and of the human and natural communities that experience those changes vary greatly from one region to another. Water shortage will be a serious problem for agricultural communities, heat stroke for urban, storm surges caused by rising seas for coastal, and ocean acidification for marine. Since each locale faces different circumstances and hence a different set of associated problems, general knowledge of adaption is insufficient for facing the task at hand.

What is needed is a bottom-up process of formulating a site-specific adaptation strategy, one that consolidates local knowledge, is linked to local circumstances, and is driven by local stakeholders themselves, such as residents and administrative entities. Internationally, we are already seeing governments and non-governmental groups alike starting to consider their options for adaption. The Asia-Pacific Adaptation Network, for example, under the auspices of the United Nations Environment Programme, operates as a network for sharing adaptation knowledge within the region.

V. Mainstreaming

Mainstreaming is the integration of adaptation considerations into important decision-making processes already in place. Despite adaptation being largely an extension of existing actions being taken in various fields, the current reality is that there are few examples of this being done. Rather than developing new measures, therefore, the most effective approach is to incorporate the adaptation perspective into existing policies on national land-use, urban planning, agricultural development, human health, and other fields with the intent of building more resilient nations.

4. Background to this Publication

Responding to the globally escalating need for an adaptation response to climate change, in 2011 the Sompo Japan Nipponkoa Environment Foundation launched the Environmental Issue Research Group, a group of experts devoted to investigating potential adaptation strategies for Japan and to sharing its findings with the public.

For a three-year period, group members and guest speakers discussed a variety of topics around the theme "Climate Change: Adapting to Natural Disaster Risk" including international trends, scientific research, theory, and initiatives by Japanese government and municipalities, businesses, and overseas stakeholders. As an interim report, the group held an open symposium in November 2012 in an effort to widely disseminate its findings.

Now, with a meeting of the IPCC's Working Group II scheduled to be held in March 2014 in Yokohama, Japan, to finalize its contribution to the Fifth Assessment Report, an assessment of the latest scientific understanding of the impacts of climate change and options for adaptation, the group has decided to compile and publish its findings. We hope this book will support vigorous adaptation efforts in various sectors and fields in Japan and abroad.

3-2-9 Initiatives in the Insurance Sector: Climate Change Adaptation and Mitigation Efforts by Sompo Japan

Hajime Sano, Hiromichi Tsumori
Sompo Japan Nipponkoa Risk Management

1. Climate Change and the Insurance Sector

Besides its other impacts, climate change can result in enormous risks to the business of insurance companies and their corporate customers. For example, the climate change-induced increase in abnormal weather risk can result in direct damage to corporate facilities, equipment, and logistics, and lead to an increase in payouts by insurance companies. To illustrate, during the mild winter of 2008–09, the sales of heating products by consumer electronics retailers dropped by half, and one ski hill after another could only operate for half of the normal ski season due to the lack of snow. These kinds of changes in weather due to climate change—while they have a substantial impact on the sales of corporate clients—can also lead to increases in the need for products and services to cover weather risk, such as weather derivatives.

In addition, in order to hold back the impacts of climate change, there are efforts under way to strengthen regulations in order to significantly reduce greenhouse gas emissions and to transition toward a low-carbon society. While these regulations increase the compliance costs of insurance companies themselves, they are also creating business opportunities in the areas of renewable energy and energy conservation, carbon capture and storage (CCS), emission trading, and so on.[1] Insurance companies outside Japan have already started to aggressively invest in the renewable energy sector and provide insurance for CCS. The transition to a low-carbon society could create major business opportunities for insurance companies as well.

2. About Sompo Japan

Built upon a foundation of property and casualty insurance, Sompo Japan has developed a wide range of business activities. It all began with the Tokyo Fire Insurance Company, founded in 1888 as Japan's first fire insurance company. Tokyo Fire has its roots in fire fighting during the Edo Period (1603–1868) in Japan as the Tokyo Fire firefighters, an in-house fire brigade, that would sprinkle water on their uniforms and rush over to customers' homes to prevent the spread of fire using a fire hook.

The basic concepts of the insurance business are "public help" from the national and local

[1] CCS is an approach to separate and recover carbon dioxide from the emissions of large emitters such as thermal power plants, and then store and isolate it underground or in the ocean for a long time, as an effort to suppress carbon dioxide emissions to the atmosphere.

government, "self-help" by the people themselves, and in the middle, "mutual help"—and realizing a society where everyone helps each other is exactly what Sompo Japan aims for.

Yasuda Fire and Marine Insurance, the predecessor of Sompo Japan, was one of Japan's first financial institutions to establish a dedicated office for global environmental risk management when it was set up in 1990, and it acquired ISO 14001 certification for environmental management systems—the first Japanese financial institution to do so—in 1997. Later, the emphasis expanded from environment to corporate social responsibility (CSR), and today, Sompo Japan lists "adaptation and mitigation to climate change" as CSR priority issues.

3. Sompo Japan's Approach to Climate Change

In recent years, societies and economies have been seriously affected by frequent and large-scale disasters resulting from natural hazards2 around the world. According to statistics compiled by Munich Re, a major reinsurance company that underwrites risk for insurance companies, large-scale disasters due to extreme weather events have been increasing worldwide since 1990, and there has been an associated increase in economic and insured losses. A large number of enormous natural hazards occurred in 2011, in particular, such as the Great East Japan Earthquake and major flooding in Thailand, with a large increase in economic losses and insurance payouts.

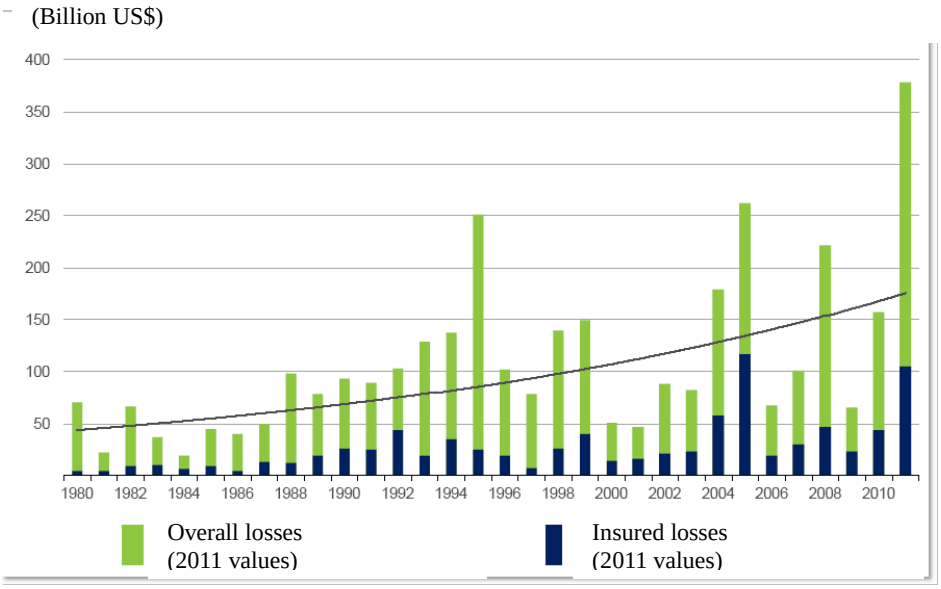

Figure 1. Overall losses and insurance losses due to disasters[3]

[2] Throughout the book, "disasters" refer to those resulting from natural hazards, unless otherwise stated.
[3] Munich Re "NatCatSERVICE"

A variety of sectors are being affected by the increase in disasters that appears to be arising from climate change, including agriculture and other primary industries, infrastructure industries such as electricity and railways, manufacturing industries such as automotive and electrical equipment, and service industries such as retail and logistics. Insurance companies undertake the risk by providing insurance to these sectors, and for insurance companies, climate change is seen as both a significant risk and a business opportunity.

Two approaches are generally taken to respond to climate change: "mitigation" and "adaptation."

Specific examples of "mitigation"—to reduce greenhouse gas emissions—include promoting and expanding the use of renewable energy, using carbon offsets, and having businesses transition to "low-carbon" (e.g., energy efficient) operations. For its part, Sompo Japan has been working to reduce environmental impacts associated with its own activities based on ISO 14001 environmental management systems. In 2008, the company obtained "Eco First" certification from Japan's Minister of the Environment and declared its intent to reduce CO2 emissions by more than 56% by 2050 compared to 2002. Sompo Japan is intensifying a variety of efforts, such as investment in energy conservation, including more efficient air conditioning and inverters for lighting, promotion of resource and energy conservation among all employees, and development of a green purchasing system for its value chain.

Sompo Japan is also making an effort to promote "mitigation" to climate change in society as a whole, through its provision of insurance and financial products and services. Examples include developing "Sompo Japan Green Open" (nicknamed "Buna no Mori," meaning beech forest) as an eco-fund to support companies that are proactive in environmental management, reducing paper use by handling insurance policy documentation online, using recycled parts to repair automobiles damaged in accidents, and offering services to support eco-friendly and safe driving.
Meanwhile, for "adaptation" to avoid or reduce the various impacts of climate change, Sompo Japan is making use of the know-how it has accumulated over the years to evaluate and quantify risks to society, and providing solutions in the form of a range of insurance products and services. One example is the weather index insurance product offered in Thailand, as described in the next section.

4. Development of Weather Index Insurance in Thailand

In 2007, the Japan Bank for International Cooperation (JBIC) created the study group of "Study on Market-based Adaptation -- the Potential of Index-based Insurance," to discuss whether or not private-sector risk financing approaches such as insurance could be effective in developing countries, which are vulnerable to the impacts of climate change and delayed in disaster preparation. Sompo Japan participated, and through this study group, targeted the Southeast Asia region, which has close connections with Japan. In particular, the focus was on the agricultural sector, which is most directly affected by climate change and for which responses are difficult for the private sector working alone.

The study group discussed the issues from a number of perspectives, including technical challenges for creating insurance in developing countries, and strategies to address them; the proper roles of the public and private sectors; and international frameworks to ensure the capacity to handle potential risks that may balloon in the future. As a result, the group concluded that weather derivatives (weather index insurance) could be an effective adaptation measure.

A weather derivative is a financial product that allows a policy holder to be paid a predetermined sum of money in the event that an index meets certain conditions (relating to temperature, wind, precipitation, snowfall, etc.). For example, regardless of whether or not any actual damage occurred, a predetermined amount of money would be paid out if rainfall is below a certain amount in July, a month that has a major impact on agricultural crop yields. The use of index products such as these can minimize the damage when unexpected weather conditions reduce profits or increase costs, by allowing insurance payouts for compensation to be made more quickly than regular insurance based on actual damage, and by avoiding secondary damage caused by any delay in recovery from a natural disaster.

Actually, these products—weather derivatives and weather index insurance—function almost identically. Products sold in Japan as weather derivatives are being sold in Thailand and other countries as insurance, with essentially the same contents.

Because weather derivatives (weather index insurance) are designed based on weather data, which is closely correlated to data on damage, the availability of reliable long-term data is essential. Thailand was selected for being an agricultural country in Southeast Asia that has an extensive system as well as advanced information technologies for weather observation. Within the country, northeast Thailand was selected for having an incomplete infrastructure for irrigation, for its dependence mainly on rain-fed farming methods, and for being generally a poor region. For these reasons, the final selection went to Khon Kaen Province in the central region of the northeastern part of the country, and rice, the country's primary crop.

To design a weather derivative (weather index insurance), it is first necessary to analyze past data on weather and rice yields in the target area. To analyze past data, cooperation was sought from the National Institute for Agro-Environmental Sciences, which is engaged in research in rice production in northeast Thailand. Then, based on the research outcomes, we developed a prototype of weather index insurance, and went to Thailand for feedback directly from farmers.

Insurance is not commonly used in rural areas of Thailand, and farmers were not familiar with products such as weather index insurance, so there was a possibility they would not accept it. To deal with this, we first created a trial insurance product, and organized presentations for local farmers, in cooperation with the Bank for Agriculture and Agricultural Cooperatives (BAAC), a governmental financial institution and a local sales partner.

This was Sompo Japan's first attempt to develop weather index insurance for a developing country, so we had some concerns about being able to have the local people understand the product. However, the response was very favorable from the first presentation, attended by about ten farmers. Thai farmers generally have the practice of borrowing money each year from a bank mainly to secure a work force, and repaying the principal and interest once they have turned their harvest into cash. If the harvest is negatively affected by drought or some other cause, their loan repayments are delayed, resulting in problems with farm operations the following year.

Figure 2. Interviews were conducted with local farmers

Figure 3. Presentations were made to explain the new concepts

Local people feel considerable anxiety about not being able to repay loans, so farmers said they would certainly use such a product if it was available, and the same response was elicited in presentations held in other areas.

Meanwhile, local farmers made many suggestions about the prototype. For example, with the original prototype, if the rainfall was below a certain amount during the three months from June to August, and rainfall in June was below a certain amount, an insurance payout would be made. Both conditions had to be met. However, farmers said that it would be simpler to have just one condition for payment, so the conditions were reduced to just one: the amount of rainfall during the three-month period. Also, farmers pointed out that rainfall in September affected harvests more than June, so the target period was changed to July to September.

These are examples of how Sompo Japan worked to reflect local input and improve the product. In order to have the farmers experience how the weather index insurance works, a simulation was conducted in 2009 without any actual exchange of insurance premiums or payments.

In parallel with this effort, Sompo Japan Thailand (currently Sompo Japan Nipponkoa Thailand), a local subsidiary of the Group, continued negotiations with the Thai insurance authorities. The company obtained official product approval for weather index insurance in December 2009, and launched its sales in January 2010.

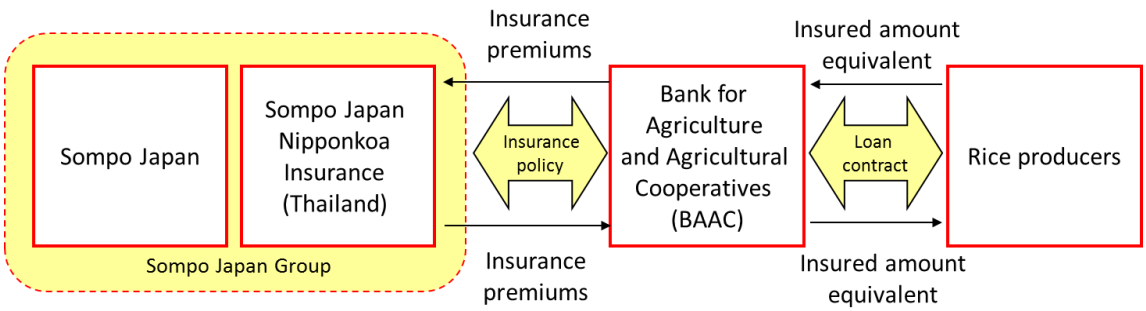

Figure 4. Weather index insurance scheme

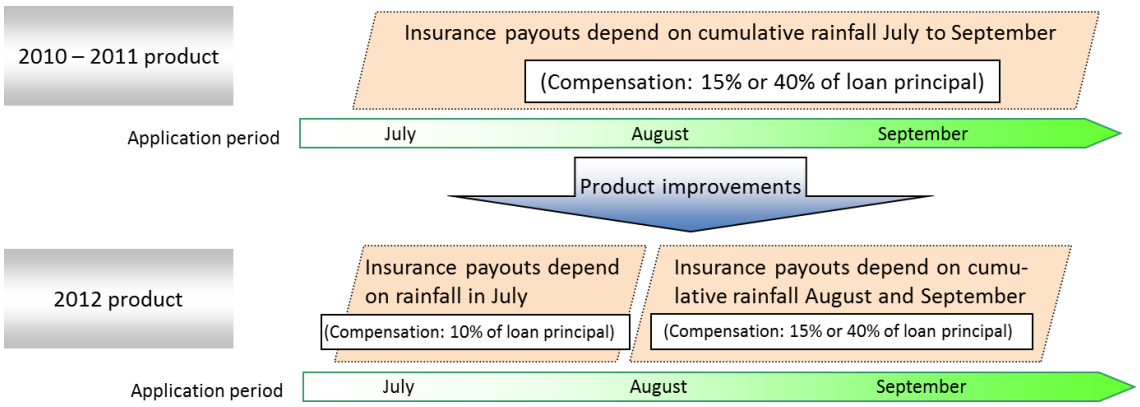

Figure 5. Product outline of Thai Weather Index Insurance

Under this arrangement, Sompo Japan Thailand underwrote the insurance contracts, while BAAC was responsible for promoting the insurance to farmers. If a drought or other circumstances arose in which an insurance payout should be made, Sompo Japan would make the insurance payment to BAAC, and BAAC would pay the equivalent amount to the farmer.

A ceremony was held in Bangkok for the product launch, attended by Thailand's Minister of Finance and the Japanese Ambassador to Thailand. The potential for weather index insurance attracted attention as an adaptation strategy to climate change.

Sompo Japan had a target of 1,000 applicants for the insurance, but was not certain what the actual response would be in northeast Thailand, where insurance was not commonly used. However, applications came in at a faster pace than expected, and the final number of contracts reached 1,158.

In fiscal 2011, the product was recognized for being easy to comprehend, and BAAC requested to expand the sales territory. As a result, the area was expanded to include four more provinces that have the confirmed and reliable meteorological data required for product development (Nakhon Ratchasima, Maha Sarakham, Kalasin, and Roi Et). With this expansion, there were over 6,000 contracts signed in fiscal 2011.

In fiscal 2012, in response to a request from BAAC and farmers, we made product improvements to enable early payouts if drought occurred in July, early in the planting season, which had a major impact on crop yields. As a result we changed the conditions, instead of counting rainfall over three months from July to September, to count the rainfall in the single month of July, or the two months of August and September. It was also decided to expand the sales territory from five provinces (Khon Kaen, Nakhon Ratchasima, Maha Sarakham, Kalasin, and Roi Et) to nine (with the addition of four—Buriram, Sisaket, Surin, and Ubon Ratchathan), all in northeast Thailand. It turned out that a drought actually did occur in some parts of northeast Thailand, so many policyholders received insurance payments, and the overall experience demonstrated the actual effectiveness and benefits of having insurance.

This process of making repeated improvements based on feedback from farmers and partners has resulted in weather index insurance becoming well established locally. It is attracting attention as one adaptation measure to reduce the risks of disasters in developing countries.

5. Development of Weather Derivatives in Japan

So far, we have looked at weather index insurance in Thailand, but know-how accumulated in the development of weather derivatives in Japan made it possible to develop these products in Thailand. Weather derivatives are traced back to their development by major energy companies in the United States in 1997. Sompo Japan was the first in Japan to start selling derivatives in December 1999, with payout criteria based on temperatures. The company has been actively selling these products since then.

It is said that weather variability affects the profits of as much as three out of four businesses to some extent. For such businesses, Sompo Japan offers order-made weather derivatives. Based on past data, we design products through discussion with customers regarding the types of indicators to use and levels of payout, etc.

Sompo Japan offers weather derivatives in a wide range of areas. For example, in the agricultural sector, we sell agricultural organizations a weather derivative to compensate for the risk of a cool summer or excessive rain. In the event of a cool summer, a certain amount of money is paid out for the total number of days the minimum temperature drops below a certain predetermined number during the period covered. With another product aiming to compensate for typhoon risk, the compensation is determined depending on the number of typhoons that go over the target area.

In the renewable energy sector, we offer a derivative to solar power generation businesses that uses sunlight hours as the indicator. This product mitigates the risk of reduced profits due to a lack of sunlight, and a predetermined amount of money will be paid if the number of sunlight hours is below a certain figure. The aim is to support the stable development of businesses in this sector. Meanwhile, for individual consumers, we have developed and offer a service that uses weather derivatives for solar power generation. This was done in cooperation with companies that install photovoltaic power generation systems on individual homes. We expect that these products will help promote the introduction of renewable energy, including solar power.

Sompo Japan aims to support the economic activities of businesses and help create a society resilient to climate change, through these products to address climate-related risks.

6. Natural Disaster Risk Assessment Model

So far this chapter has touched upon weather index insurance and weather derivatives that Sompo Japan offers in Japan and Thailand, but the design of these types of insurance and financial products requires quantitative assessments of the risks being covered.

The quantitative assessment of risks typically uses "disaster risk assessment models," which are a

sophisticated combination of numerical models, including statistical, physical, and financial models. Sompo Japan has developed its own in-house model for such risks as earthquakes, typhoons, floods, and tsunamis. The insurance loss amounts assessed by the model are useful for designing insurance products and for management decisions by insurance companies.

As an example of a natural disaster risk assessment model, below we introduce a typhoon model developed by Sompo Japan Group companies. The typhoon model is based on data from past observation. It statistically models typhoon characteristics such as where typhoons develop, what path they follow, and how strong they are. Then, based on this model, it conducts a random simulation by computer, prepares a few hundred to a few thousand years' worth of hypothetical typhoon events, and creates a typhoon event set. The event set includes large-scale typhoon events that rarely occur, making it possible to quantitatively assess risk, even for major typhoon disasters that have never been experienced in the past.

To implement climate change adaptation measures, it is necessary to quantify changes in future risk based on natural disaster risk assessment models. These models use statistical models and random simulations to model past characteristics, and quantify probabilistic risk by recreating a large number of disaster events based on those characteristics. Meanwhile, it has been pointed out that the frequency and intensity of disasters themselves may change as a result of climate change. Thus, in terms of evaluating medium and long term changes in the amount of risk, there may be limits to what can be accomplished by using only disaster risk assessment models, which come from statistical methods using historical data.

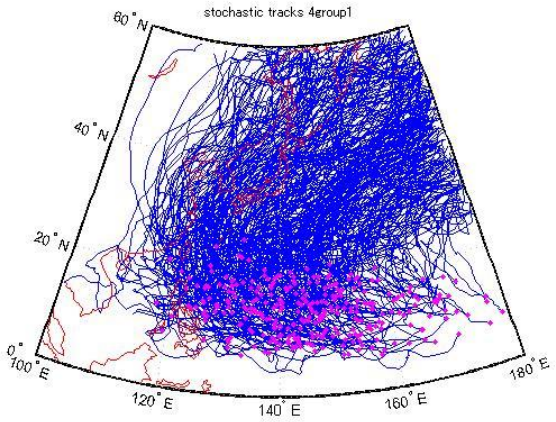

Figure 6. Hypothetical typhoon events generated by typhoon model

One approach to deal with this is to incorporate the results of climate change prediction simulations into the disaster risk assessment model. For example, in the United Kingdom, the Association of British Insurers teamed up with the Meteorological Office to implement a joint project to predict future changes in storm disaster risk. They evaluated the value of total and annual expected losses from climate change impacts generated for a period of 100 to 200 years. Insurance companies are basing their medium and long term risk management upon these assessment results.

Working with the Disaster Prevention Research Institute at Kyoto University, Sompo Japan is conducting joint research and development of a national flood model that takes into account the impacts of climate change. Combining Kyoto University's know-how, relating to analysis of changes in precipitation as well as river flow and flood calculations, with Sompo Japan's risk assessment know-how relating to insurance damage, we are aiming to quantitatively evaluate flood risk nationwide from the economic perspective.

7. Moving toward a Sustainable Society

Climate change is an unprecedented challenge that will result in extensive damage to various sectors of society. It is a major business challenge for the insurance industry in particular, as the increase in disasters is leading to an increase in insurance claims paid.

The societal mission of insurance companies is to evaluate risks in society and the economy and to provide solutions in the form of insurance and financial products and services. The sustainability of society is threatened by climate change, but we hope that Sompo Japan can contribute to the realization of a sustainable society with solutions for climate risk, and also to advance the sustainable growth of insurance companies themselves.

The Task Ahead for Japan

Masako Seki
Sompo Japan Nipponkoa Environment Foundation (SJNKEF)

In the present chapter, I will summarize the discussions in Chapters 1 through 3 as well as the assessments made by SJNKEF's Environmental Issue Research Group and the outcomes of its interim report symposium.[1] I will also make policy recommendations for each of the challenges identified.

1. Climate Change Policy: Combining Mitigation and Adaptation

Climate change has become a reality and it is getting worse. Efforts to reduce emissions of greenhouse gases and stabilize the climate through mitigation, however, have not delivered the anticipated results.
Total global emissions need to be reduced to half their current level (30 billion tons per year) by 2050 in order to stabilize climate and limit global temperature rise to 2 degrees Celsius above pre-industrial levels. That is 8 billion tons (8Gt) more than the combined reductions currently pledged by the world's nations—a problem dubbed the "gigaton gap."

As described in 1-1 Climate Change Impacts, as mitigation efforts take time to yield tangible results, the projected impacts of climate change have started to appear all around us. One impact is the central theme of this book: the growing frequency and intensity of disasters resulting from natural hazards. The impacts of disaster, while common to nations both developed and developing, are intensifying nowhere as in Asia.
Like the wheels of a car, mitigation and adaptation must be pursued in a balanced manner: reducing greenhouse gas emissions to stabilize climate while adjusting ourselves well to changing climate and sustaining life and productive capacities. The reality, however, is that adaptation has taken a back seat to mitigation. There are also some who, hoping to prevent the misconception that adaptation by itself is a viable solution, caution against focusing too much on adaptation, lest resources be diverted away from mitigation.

The problem of climate change cannot be solved through mitigation or adaptation alone. As discussed in 1-2 Practical Challenges to Adaptation, measures should be chosen in a way that, capitalizing on the synergies between mitigation and adaptation, enhances the effectiveness of both sets of measures and secures the highest cost-effectiveness overall. As touched on in 1-3 Recent Developments in International Adaptation Negotiations, more capital, technology and skills are needed to implement adaptation measures, especially in developing countries. Ways to expand financing and provide effective technical support for adaptation measures deserve more consideration. New mechanisms also need to be created that will direct the attention of governments of developing countries toward assessing long-term risks. At any rate, real action on adaptation is yet to come.

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[1] Interim report symposium of the Environmental Issue Research Group, Sompo Japan Nipponkoa Environment Foundation (November 2012), Toward a Climate Resilient Society, http://www.sjnkef.org/about/sje_symposium2012/ (Japanese).

2. Recommendations for Addressing Adaptation Challenges

Adaptation must be made a higher priority in all areas of society going forward. To start, it is crucial that all stakeholders work broadly to raise awareness of adaptation and its importance, which is far from where it needs to be. The sharing of scientific knowledge is a critical part of this effort.

In this book, we have presented the latest findings on adaptation from both the theoretical and practical standpoints, together with specific examples. Based on the conclusions derived from these discussions, I would like to recommend some basic strategies that would be considered particularly important when promoting the implementation of specific adaptation measures.

Table 1. Recommendations for addressing adaptation challenges

Climate change characteristic	**Challenge**	**Recommended strategy**
Irreversibility	Once set in motion, impacts can result in irreparable, irreversible changes	Precautionary measures that preempt changes
Prolonged impacts	Sea-level rise and other global warming impacts occur over a long period	
Uncertainty	Where, when, what, and the degree to which changes will occur are still hard to predict	Flexible, adaptive approach that regularly revises adaptation measures to reflect progress in scientific understanding and changing circumstances
Site-specificity and variability	Because climate changes, while globally prevalent, vary greatly from one region to another, general knowledge of adaptation is insufficient	Multi-stakeholder process that combines top-down and bottom-up approaches and is linked to local circumstances
Mainstreaming	There are few examples of the adaptation perspective being integrated into existing activities	Adaptation measures that are integrated into day-to-day decisions and actions

I. Precautionary approach

Irreparable and irreversible events due to climate change, such as widespread ecological change and species loss, are likely to take place on a global scale in the coming future, and some of these

phenomena are already being observed. Global warming impacts such as sea-level rise, for instance, will take place over the course of centuries.
Adaptation measures, therefore, should be devised in consideration of Principle 15 of the Rio Declaration—i.e., the precautionary approach—announced at the United Nations Conference on Environment and Development (Earth Summit) held in Rio de Janeiro, Brazil, in 1992.

Principle 15 states that "in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."
While such cost-effective measures should not be postponed, their costs and benefits must be assessed not from the short but rather the medium to long term perspective; this position is also taken in the Stern Review.[2,3] And as stated in 2-4 How Should the Cost of Disasters Be Assessed?, the damages wrought by climate change need to be perceived from a broader perspective.

II. Flexible, adaptive approach

Despite the progress made in climate modeling research, uncertainty remains; scientists are still unable to adequately predict where, when, what, and the degree to which changes will occur. As discussed in 2-5 When Should Measures be Implemented?, making decisions within a context of uncertain and irreversible change is difficult.

However, the stance of withholding action until climate change projections can be made with a higher degree of certainty poses the greater risk. The more effective strategy would be to take action based on our current scientific understanding, and then to modify initial plans as circumstances change and research progresses. This adaptive approach should be combined with the precautionary approach, which explains how decisions should be made within a context of uncertainty.

The IPCC Fifth Assessment Report (AR5) to be released in the first half of 2014 will bring our scientific understanding of climate change up to date. Since AR5 is intended to be used as a basis for determining public policy, it goes without saying that public policy will also require updating. As research on the effects of climate change progresses, more precise and more accurate projections and research data will emerge for each region and field. Therefore, adaptation measures must be considered from a broad, flexible mindset that, viewing uncertainty as a given, takes into account ongoing developments in our scientific understanding and in surrounding circumstances.[4]

As described in 3-1-2 Adaptation Efforts in the UK, Britain's national strategy has included a process

[2] Nicholas Stern's "The Economics of Climate Change" (2006) states that extensive economic loss amounting to between 5% and up to 20% of GDP could be averted by directing 1% of GDP toward climate actions.

[3] The environment section of ISO 26000, the international guidance on social responsibility, provides the following statement regarding the precautionary principle: "When considering the cost-effectiveness of actions, organizations should consider not only the organization's short-term economic costs but also the long-term costs and benefits of those actions."

[4] Consider the following remarks made by Prof. Nobuo Mimura at the interim report symposium of SJNKEF: "Real-time adaptation, a strategy that includes monitoring and early warning systems based on current policy, should be implemented in the near term, while adaptive adaptation, a strategy where adaptation measures are periodically revised by incorporating the latest scientific information, should be adopted over the medium to long term." (Global Environmental Forum, "Global Net" Issue 267, February 2013)

of periodic revision from the very beginning. And in 3-1-4 Adaptation from a Local Government Perspective, we touched on the effectiveness of an approach where plans and targets are revised at certain times as changes happen. These serve as examples of the need for an approach that employs a flexible, adaptive response based on ongoing developments in our scientific understanding and surrounding circumstances.

Responding flexibly amidst uncertainty also requires an effective combination of hard (tangible) and soft (intangible) measures. As presented in 2-2 Disaster Risk Management as an Adaptation Strategy in a Changing Climate, 2-3 Risk Finance, and 2-7 Government Involvement in Creating Effective Insurance for Water-Related Disasters, both hard and soft measures can be taken for adapting to the projected rise in weather disasters. Hard measures include infrastructural projects such as the construction of dams and breakwaters, while soft measures include evacuation drills, insurance that provides assistance for post-disaster reconstruction, and voluntary grassroots activities.

When you consider the 30 to 100-year replacement cycle for infrastructure, the skillful application of soft measures provides flexibility for deciding the timing and size of hard measures, which are often costly. It also makes it possible to plan and implement adaptation measures in a timely manner as scientific knowledge develops and circumstances change.

III. Multi-stakeholder process

Because the effects of climate change vary by region, a blanket top-down approach to adaptation is inadequate; a bottom-up process that takes local circumstances into account is also necessary. Underscoring this is the fact that local stakeholders do much of the work of implementing a wide range of solutions.

For example, as described in 3-1-5 History and Case Study of Adaptation Measures in Nagano, direct involvement of citizens in the monitoring of climate change impacts helps them become more aware of the issue on a routine basis.

Adaptation thus is by necessity a local effort, with specific actions necessary for each of the varying effects that can take place in the natural, economic, and social environments. Consequently, it is essential that diverse stakeholders voluntarily work toward implementing solutions.

For that to happen, a participatory process whereby stakeholders can take part in discussing, deciding, and implementing actions is critical. Since the interests of such groups vary, however, this process can also engender negative secondary effects or situations involving trade-offs. Consensus must be built, therefore, among stakeholder groups through information sharing and dialogue. A collaborative multi-stakeholder process in which various entities participate, come to agreement, and take action is effective for advancing adaptation from the bottom up. Indeed, as touched on in Chapter 3, Section 3 Grassroots Initiatives, a sufficient impact is hard to achieve without the involvement of local residents and various other stakeholders.

While partnership is an effective means of solving problems in general, this is especially true of adaptation, and for various reasons: Enhancing a community's adaptive capacity as a whole requires a range of measures, which require the participation of many stakeholders; a sustained effort is needed to enhance resilience over the long term; and cross-organizational mechanisms that optimize

the adaptation effort as a whole are necessary and also improve the effectiveness of individual actions.

It is especially important that governments and businesses share scientific knowledge as a basis for partnership and apply the same understanding to their strategies and actions. For that reason, increased dialogue and collaboration is needed between researchers and decision makers in public policy and business. Such cross-sector partnership will likely enable more effective use of talent, know-how, and financial resources.

Indeed, as we saw in Chapter 3 Adaptation in Practice, new pilot projects are being launched around the world that, through collaboration between various stakeholders, including UN agencies, local governments, NGOs, businesses, and local residents, aim to address vulnerabilities to climate change, end poverty, and build more vibrant communities.

IV. Top-down and bottom-up approaches

As stated in 3-1-3 Trends and Challenges to Adaptation Efforts by Local Governments, a lack of clear priority given to adaptation on a national policy level can hinder the progress of adaptation efforts by local governments, a key stakeholder for advancing work on the ground.

Assigning adaptation a place in national strategy is essential to advancing adaptation measures in Japan. Countries such as the US, UK, and EU, as well as China and South Korea in Asia, are leading the formulation of such a strategy, called a national adaptation plan (NAP). As mentioned in 3-1-1 Adaptation Efforts in Japan, the Japanese government intends to formulate its own adaptation plan around the summer of 2015. This is a necessary step toward raising adaptation as a national priority. Government leaders can start the process by clarifying their commitment to adaptation as a leading policy issue.

Formulating a national plan from a top-down approach provides a basis for local governments to prepare their own plans and take other actions. It substantiates the implementation of necessary budgetary and policy actions, and provides support for advancing concrete adaptation policies.
As stated in 2-6 Government Support for Smart Action on Disasters, "strict" interventions that force or limit corporate and civic selection of adaptation measures may be necessary. But more emphasis should be placed on "light" interventions that support smarter, more effective adaptation choices in the market.

A global perspective is also needed, for the impacts of climate change are global. As mentioned in 3-2-2 Efforts in the Manufacturing Sector, the 2011 floods in Thailand dealt a heavy blow to Japanese companies with their supply chain, and as cross-border dependency deepens, Japan will continue to face major impacts from natural disasters and other events that happen in other countries. Japan, therefore, needs not only to increase resilience domestically but also to more actively involve itself in the problems of countries in Asia and other regions that are vulnerable to climate change. International networks of researchers and other stakeholders are being created, such as the Global Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA) and the Asia Pacific Adaptation Network (APAN), presented in 1-1 Climate Change Impacts. Japan must actively participate in and make its own contribution to these networks.

In parallel to this national-level strategy building, various examples of action and partnership among various stakeholders on a local-community level in Japan and elsewhere in the world are starting to emerge. Some of these were covered in the local government initiatives presented in 3-1-3, 3-1-4, 3-1-5, in Chapter 3, Section 2 Corporate Initiatives, and Chapter 3, Section 3 Grassroots Initiatives.
Only through a combination of these two processes—a top-down process on a national level, and a bottom-up process involving multiple sectors in various parallel initiatives on a local and global level—can effective adaptation be achieved.

As a result, global mechanisms that coordinate adaptation efforts to ensure that both processes complement each other and are well synchronized will be important going forward. As a leading example, Australia, following federal government plans, established the Queensland Climate Change Centre of Excellence (QCCCE) through which it is comprehensively promoting activities by various local sectors. Through programs intended to encourage participation and voluntary action from a wide range of stakeholders, such as roundtable meetings for businesses, awards for best practices, and a registration system for disaster response volunteers, the QCCCE is systematically advancing adaptation measures on a community level.

V. Mainstreaming

Mainstreaming refers to the integration of adaptation considerations into existing decision-making processes. It is the act and process of various stakeholders incorporating adaptation into their business or activities, not as a special concern but as part of their routine decision-making and behavior. For central governments this means weaving adaptation—i.e., management of climate change risks—into the policies of their respective administrative agencies, and for companies, into their business strategy and the operations of their respective divisions.
Despite the growing move to view climate change as a risk management issue, as discussed in 2-1 Climate Change Risk Management and Risk Analysis, there are as yet few cases of adaptation perspective being incorporated into existing risk management systems in a cross-organizational manner. As stated in 2-2 Disaster Risk Management as an Adaptation Strategy in a Changing Climate, we would like to see adaptation used as an opportunity for developing a new integrated approach to managing risk.

One obstacle to mainstreaming adaptation is conventionalism. Whether it is a central government, corporation, or non-profit, many organizations frequently rely on past experience and statistical data when making decisions. Formulating and implementing plans based solely on past experience and custom can make an organization ill-prepared for new risks and changes that can arise in the future. In 3-3-2 Initiatives in the Philippines, India, and Ethiopia, we gave examples of development aid being given based on analysis of the effects of climate change on certain communities. As these examples show, the results of projection modeling and simulations should be factored into decisions. To be sure, there exists a certain amount of opposition and resistance to making decisions based on uncertain projections. But the reality is that this process is necessary for making organizations and societies more resilient.

Another factor critical to the success of a mainstreaming effort is the elimination or overcoming of silo mentality within organizations. As explained in 3-1-5 History and Case Study of Adaptation Measures in Nagano, Nagano Prefecture held discussions involving all agencies relevant to the various themes of adaptation, such as disaster risk management, agriculture, human health, tourism,

and the environment. Rather than each agency laboring alone, it is important to have cross-functional discussions.

When it later comes to implementation, it is also crucial that adaptation measures be incorporated into daily procedures and continually checked and improved upon through a PDCA cycle, rather than being made into a temporary, one-time effort.

3. The role of business and various sectors

Building a climate-resilient society requires the participation of many stakeholders. These stakeholders are called upon to work on integrating adaptation into their daily activities, or within the framework or as an extension of their existing project.

At the same time, however, some aspects of climate change will require measures that entail a major reworking of social structures, or groundbreaking ways of overcoming the obstacles created by conventional knowledge and existing technologies. In short: technical and social innovation is needed. As a result, increasing expectations are being placed on companies that possess innovative problem-solving skills and can provide new solutions related to adaptation. An effective way to harness the potential of such businesses is to integrate adaptation into the economy—in other words, to use the power of the market to encourage companies to view and tackle adaptation as a business opportunity. It is desirable to frame adaptation as a new growth area, and to bring the problem-solving capabilities of such companies to bear in advancing adaptation through their innovations.

That said, climate adaptation as a market is still in its infancy. There are few examples of corporations going beyond risk management as a form of self-protection to actually taking action, as a business opportunity, to enhance the resilience of greater society. As covered in Chapter 3, Section 2 Corporate Initiatives, however, some innovative examples are emerging in the various corporate sectors.

While leveraging the power of innovation in the corporate sector in this way, quicker action on adaptation is needed from central and local governments, citizens, researchers, and all other stakeholders. The time has come when our ability to share and act on scientific knowledge and work together to effect bold changes will determine our collective fate.

References

Ueda, K., Otsuka, T., Sompo Japan Insurance Inc., and Sompo Japan Nipponkoa Environment Foundation (Yuhikaku Publishing Co., Ltd., 2010), Environmental Risk Management and the Precautionary Principle (Japanese).

IPCC (2007), Summary for Policymakers. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7-22.

Stern, N. (2006), The Stern Review: The Economics of Climate Change.

Queensland Government (2011), Climate Change: Adaptation for Queensland - Issues Paper -.

Deloitte (2013), Building our nation's resilience to natural disasters Australian Business Roundtable for Disaster Resilience, and Safer Communities.