RECOMMENDATION

Building a sustainable global society by strengthening disaster resilience:

- Developing an "Online Synthesis System (OSS)"

and fostering "Facilitators" to realize consilience -

September 18, 2020

Science Council of Japan

Committee on International Cooperation

for Promoting Science-Based Disaster Risk Reduction

This Recommendation has compiled and published the outcome of deliberations in the Committee on International Cooperation for Promoting Science-Based Disaster Risk Reduction.

Member List

Chair	KOIKE Toshio	Executive Director, International Centre for Water Hazard and Risk Management (ICHARM), Public Works Research Institute (PWRI) Professor Emeritus, the University of Tokyo
Vice-Chair	HAYASHI Haruo	President, National Research Institute for Earth Science and Disaster Resilience (NIED)
Secretary	KAWASAKI Akiyuki	Project Professor, Department of Civil Engineering, the University of Tokyo
Secretary	SATAKE Kenji	Professor, Director, Earthquake Research Institute, the University of Tokyo
	AMANO Yusuke	Senior Vice President, Japan International Cooperation Agency
	HANAKI Keisuke	Professor, School of Information Networking for Innovation and Design, Toyo University
	HARUYAMA Shigeko	Professor Emerita, Mie University
	HIROKI Kenzo	Professor, National Graduate Institute for Policy Studies (GRIPS)
	KASUGA Fumiko	Senior Fellow, National Institute for Environmental Studies
	KOMATSU Toshimitsu	Professor Emeritus, Kyushu University
	KOMORI Daisuke	Associate Professor, Department of Civil Engineering, Tohoku University
	MEGURO Kimiro	Professor, Institute of Industrial Science, the University of Tokyo
	MIDORIKAWA Mitsumasa	President, National Research and Development Agency, Building Research Institute Professor Emeritus, Hokkaido University
	MIKI Koichi	Professor, Keio University
	MINAMI Hiroko	Professor, President, Kobe City College of Nursing
	MOCHIZUKI Tsuneyoshi	Advisor, Economic Research Association Special Advisor, Japan River Association
	NISHIGUCHI Hiro	President, Japan Bosai Platform
	NISHIJIMA Kazuyoshi	Associate Professor, Disaster Prevention Research

	Institute, Kyoto University
NISHIKAWA Satoru	Professor, Disaster Mitigation Research Center, Nagoya University
ONISHI Takashi	Emeritus Professor, the University of Tokyo
ONO Yuichi	Professor, International Research Institute of Disaster Science, Tohoku University
SAYA Setsuko	Executive Fellow, The Overseas Construction Association of Japan, Inc.
SHAW Rajib	Professor, Graduate School of Media and Governance, Keio University
TAKAHASHI Yoshikazu	Professor, Department of Civil and Earth Resources Engineering, Kyoto University
TAKARA Kaoru	Dean and Professor, Graduate School of Advanced Integrated Studies in Human Survivability (Shishu-Kan), Kyoto University
TAKEUCHI Kazuhiko	President, Institute for Global Environmental Strategies (IGES) Project Professor, Institute for Future Initiatives, the University of Tokyo
TAMURA Keiko	Professor, Risk Management Office, Headquarters for Risk Management, Niigata University
TSUKAHARA Kenichi	Professor, Graduate School of Engineering, Kyushu University
YAMAOKA Koshun	Professor, Graduate School of Environmental Studies, Nagoya University
YAMAKAWA Mitsuo	Professor Emeritus, Fukushima University
YONEDA Masako	Professor, Graduate School of Media and Governance, Keio University
WADA Akira	Professor Emeritus, Tokyo Institute of Technology

Acknowledgements

The following members have contributed to this Recommendation.

HORI Muneo	Director-General, Research Institute for Value-Added-Information Generation, Japan Agency for Marine-Earth Science and Technology
IKEDA Tetsuya	Director for Special Research, International Centre for Water Hazard and Risk Management (ICHARM), Public Works Research Institute (PWRI)
NAKAJIMA Soichi	Deputy Director-General, Land and Property Department, Japan

	Water Agency
TABATA Kentaro	Chief Researcher, National Research Institute for Earth Science and Disaster Resilience (NIED)
TATANO Hirokazu	Professor, Disaster Prevention Research Institute, Kyoto University
YAMAZAKI-HONDA Ritsuko	Deputy Director-General, National Research Institute for Earth Science and Disaster Resilience (NIED)

The following staff in Science Council of Japan (SCJ), Cabinet Office has worked as Secretariat; MATSUMURO Kanji, IGARASHI Kurumi, KOMODA Yukiko, and OSAWA Yuki.

The following staff has contributed to the draft of this English version; NAKAJIMA Soichi, YAMAZAKI-HONDA Ritsuko, OKOUCHI Masatoshi, MUROMACHI Hiroko, BULGAREVICH Anton (NIED) and OKUBO Masahiko (ICHARM) as well as ITO Ai (SCJ). Proofreading was made by Dr. KOIKE, Dr. HAYASHI, Dr. HIROKI, Dr. KASUGA, Dr. NISHIKAWA, Dr. ONO, Dr. SHAW, and Dr. TAKARA.

Executive Summary

1. Background

"The Sendai Framework for Disaster Risk Reduction 2015-2030" [1] (hereinafter, the Sendai Framework) was adopted in March 2015 as an international guideline for disaster risk reduction (DRR), then followed by the adoption of the "Transforming Our World: the 2030 Agenda for Sustainable Development" [2] (hereinafter, the 2030 Agenda) in September 2015. Recent discussions call for the promotion of both frameworks in an integrated manner under the expectation of strengthening disaster resilience to reduce impacts from disaster, overcome loss and damage, and recover, as prerequisites for achieving sustainable development. Based on the understanding that the aforementioned two international challenges derived from different background and standpoints, there is a need to propose ideal views, support social implementation, improve better understanding based on practical experience, and develop an intellectual cyclic system. In this cycle, large expectations are laid for science.

2. Status and Challenges

On the basis that disaster resilience and sustainable development are closely and structurally interlinked, it is necessary to understand their contents in a comprehensive manner, study their causes thoroughly, and conduct planning/implementation/evaluation for resolution. Actions are required to duly understand the issues and produce new values through practice of learning and improvement.

"Consilience" in DRR and Environment/Development should be conducted in a comprehensive manner at the "on-site" where various issues arise. On-site stakeholders from national government, local governments/companies/organizations, communities, and residents should recognize risk on disasters and Environment/Development in an integrated manner and share them widely and then take actions in accordance with each on-site situation. To this end, on-site stakeholders and the scientific community, comprising universities and scientific institutions involved in disaster resilience and sustainable development (hereinafter called the scientific community), should hold serious communications in their mother tongue on a regular basis, take a holistic view of related data and information as well as other practices/issues, and draw ideal future pictures and design actions to be taken in a comprehensive manner. These actions will lead to provision of integrated scenarios to enhance disaster resilience and promote sustainable development based on scientific knowledge. This whole process is hereby called "synthesis."

On-site stakeholders, however, see challenges in leaving their areas and acquiring information of their non-professional subjects; therefore, they face difficulties in making decisions and taking actions to resolve on-site issues based on a multilateral analysis. In many cases, exertion of each actor's creativity is limited and fostering of "zest for living" is hampered, and sustainability is not improved as a result. To resolve this challenge, as SCJ highlighted in "Proposal toward 'consilience' as science for society," it is necessary to create "consilience knowledge base" and cultivate and increase human resources who will undertake development and management of the knowledge base. This Recommendation

defines the base as “Online Synthesis System (OSS) for the Promotion of DRR and Sustainable Development” and the human resources as “Facilitators.” Although a Facilitator may usually be considered just as “a master of ceremony,” this Recommendation defines it as “catalytic beings who has functions to moderate meetings, to lead toward resolving problems, and to provide professional advice on-site.”

3. Recommendations

Recommendation 1: The scientific community should develop the Online Synthesis System (OSS) to promote DRR and Sustainable Development.

To support enhancement of synthesis for strengthening disaster resilience and promoting sustainable development, the scientific community should develop the Online Synthesis Systems (OSS) under interdisciplinary cooperation with international scientific organizations, various on-site stakeholders, and UN/international agencies. The OSS should be equipped with functions for users to explore, collect, archive, and search in various languages, scientific information as well as information of experiences, including good practices and success/failure stories, shared from all over the world and basic information on legal systems and policies. The OSS should also have functions to integrate these data and information, conduct forecast and simulation, facilitate effective risk communications through visualization, and establish information exchange and dialogue among stakeholders. The OSS should be functional in each mother tongue so that it will be used in each country under international cooperation.

Recommendation 2: The scientific community should foster Facilitators.

Knowledge, experiences, and methods suitable for their location should be provided and external experiences and resources should be effectively introduced so that on-site stakeholders can in an inclusive and participatory manner enhance disaster resilience and sustainable development effectively, taking advantage of the OSS and based on integrated scientific knowledge. To do so, Facilitators are required to assist stakeholders who effectively apply science and technology, protect their lives and assets, and continue their livelihoods and businesses. Therefore, the scientific community should foster Facilitators in collaboration with local universities, disaster research centers, and scientific institutions and in mutual cooperation with society.

Recommendation 3: On-site stakeholders, in cooperation with Facilitators and effectively taking advantage of the OSS, should develop integrated scenarios for DRR and Environment/Development and execute concrete measures toward enhancement of disaster resilience and achievement of SDGs.

On-site stakeholders and the scientific community should take collaborative actions, with effective utilization of OSS and support from Facilitators, by sharing the understanding of disaster risk through every dialogue, forming a cyclic system of consilience, discovering the relationship of causes and effects between DRR and Environment/Development scientifically, and deepening quantitative understanding. Above all they should clarify the effects and roles of DRR in achieving SDGs and reflect them on their activities.

Recommendation 4: International scientific organizations, UN/international agencies and international aid agencies should support the development of the OSS, Facilitators and integrated scenarios for each country and region to take actions.

International and regional scientific organizations should accelerate activities of scientific communities in countries in terms of knowledge sharing on science and technology and designing information base. UN/international agencies and international aid agencies should establish a system to assist countries to raise awareness on the above, and develop and manage the information base in the context of improving quality and effectiveness of assistance in DRR and Environment/Development fields.

Table of Contents

1. Basic approach

"The Sendai Framework for Disaster Risk Reduction 2015-2030" [1] (hereinafter, the Sendai Framework) was adopted in March 2015 as an international guideline for disaster risk reduction (DRR), which was followed by the adoption of the "Transforming Our World: the 2030 Agenda for Sustainable Development" [2] (hereinafter, the 2030 Agenda) in September 2015. Recently there has been discussion that both frameworks should be promoted in an integrated manner.

To address the issues raised in these international guidelines, it is vital to establish "Science for Human and Society." Science Council of Japan (SCJ) has developed a concept of "consilience" that forms a network of society and science and circulates the knowledge between them. In parallel, in the international community, "Future Earth" has been promoted toward aiming at transformations to a sustainable society with various stakeholders involved beyond specific fields and sectors. In Japan, "Society 5.0" has been promoted to change "a state of society" by integrating and analyzing data and information in cyberspace and applying them to physical spaces.

In conjunction with these initiatives, SCJ convened two international conferences, issuing recommendations and two international statements[3][4][5]. In November 2017, SCJ presented the statement on the roles of science and technology and concrete action policies to achieve sustainable development through building a resilient society capable of minimizing impacts by disasters and overcoming and restoring loss/damage. To this end, we propose to establish the functions necessary to achieve these goals and promote the international development of science with a focus on promoting cooperation between DRR and Environment/Development.

2. Recent global trends in disaster risk reduction

Starting with the adoption of the Sendai Framework at the third United Nations World Conference on DRR in March 2015, the international communities agreed on the Addis Ababa Action Agenda in July, the 2030 Agenda in September, the Paris Agreement on Climate Change in December 2015 and the New Urban Agenda (also called the Quito Declaration) in October 2016. Based on a series of these global frameworks, a universal call for action has been made to end poverty, protect the planet, and enable anyone to enjoy peace and prosperity. Furthermore, as its premise, the importance has been emphasized to enhance disaster resilience and reduce disaster risk based on scientific and technological understanding.

United Nations Office for Disaster Risk Reduction (UNDRR) organized the Global Platform for DRR (GPDRR) in 2019 with the theme "Resilience Dividend: Toward Sustainable and Inclusive Societies," whose Co-Chair's Summary concluded that "risk-informed investments are essential for sustainable development and inclusive societies." [6] "The Means Necessary - A stakeholder declaration to the 2019 GPDRR" [7], submitted to the GPDRR emphasized the need for development that takes into account disaster risk in all aspects of the Sustainable Development Goals (SDGs) from local to global scales.

The Report of the Secretary-General of the United Nations at the 2019 UN High-Level Political Forum on Sustainable Development (HLPF) refers to the term "disaster" nine times, particularly in the part of Goal 1 "End Poverty," and emphasizes that higher ratio of economic loss caused by disasters in the poorest countries is an obstacle to eradicate poverty. The Report also highlighted "All risk-management measures must be human-centered and

ensure a whole of society approach" in the chapter of responding to gaps and accelerating implementation[8].

International discussions on DRR and those on Environment/Development have been conducted under separate tracks. International and regional cooperation for DRR started with the designation of the 1990s as the International Decade for Natural Disaster Reduction (IDNDR) to substantially reduce damages caused by natural disasters through concerted international action. The first UN World Conference on Natural Disaster Reduction was convened in Yokohama in 1994, adopted the Yokohama Strategy and Plan of Action, followed by the second UN World Conference on Disaster Reduction in Kobe in 2005, adopted the Hyogo Framework for Action (HFA) and the third UN World Conference on Disaster Risk Reduction in Sendai in 2015, adopted the Sendai Framework. The premise of these series of international discussions for almost a quarter century is that national governments have the primary responsibility for DRR.

On the other hand, discussions on Environment/Development were compelled to challenge the barriers of North-South Problems from the beginning. At the United Nations Conference on the Human Environment held in Stockholm in 1972, developed countries focused on the issue of pollution caused by contamination of air, water, and soils, yet developing countries insisted that poverty was the greatest environmental problem, claiming that they wanted development even if it might cause pollution. To overcome such conflicts, the World Commission on Environment and Development (called "Brundtland Commission") launched the concept of Sustainable Development in 1987. This concept has resulted in SDGs consisting of 17 goals and 169 targets through discussions held in the three following UN Earth Summits (Rio de Janeiro in 1992, Johannesburg in 2002, and Rio de Janeiro in 2012). Since Rachel Carson raised the issues in "Silent Spring" in 1962, it took more than a half century.

To meet the recent expectations of the international community on strengthening disaster resilience toward achievement of sustainable development, it is necessary to understand various issues in the international community, whose backgrounds, histories, and standpoints are different from each other. Also, it is necessary to support the realization of society, deepen the understanding through such experiences, and construct a cyclic structure to create a better future. Science plays an important role in this series of intellectual processes.

3. Academic approaches to support new trends

Both DRR and Environment/Development consist of a set of issues that can be explored as scientific questions, yet cannot be answered only scientifically in the end, and stand at the border between the field of science and that of political or social decision making. The discussion on "Science for Human and Society" was triggered by response to the criticism against science.

In the process of the administrative reform of Japan, SCJ was under the criticism that its raison d'etre was hard to be understood by citizens. In response to such criticism, at the beginning of its 18th term (2000-2003), SCJ started to discuss a new scientific system based on circumstances surrounding science and the relationship between science and society, and finalized the report "A New Scientific System – science for society and harmonization of social and natural sciences." The report points out the following: First, the separation of social and natural sciences can be explained by the difference in scientific principles. Physics is

governed by rules that allow neither transformation nor disobedience; Biology by rules that allow transformation but do not allow disobedience; and Sociology by rules that allow both transformation and disobedience. Since the human information processing ability is limited, it is inevitable for each of the three scientific fields to be isolated and divided. Moreover, the concept of "science for human and society" has been directly supported by practical knowledge in the fields such as engineering, agriculture, medical science/ dentistry/pharmaceutical science/nursing science, policy science, and normative science, as well as by practical aspects of fields such as education, psychology, sociology, legal studies, political science, economics, commercial science, and business science. However, the two areas are divided by historically formed practical, individual, and specific issues and are not understood in a unified framework.

Therefore, the report proposes to redefine theoretical and experiential knowledge activities aiming to recognize phenomena as "cognizing science," which defines those aiming to produce and improve phenomena as "designing science" and introduces them into the scientific system[9].

In its 20th term (2005-2008), SCJ issued an external report "Proposal: Integration of Knowledge - Toward Science for Society -." The report points out that knowledge derived by cognizing science becomes practical through artificial materials and system/measures devised by designing science and this relationship could often produce new knowledge. Therefore, it proposes that enhanced linkage between cognizing science and designing science is important for "science for society." [10]

In its 21st term (2008-2011), SCJ issued the report "Recommendation Toward 'Consilience' as Science for Society." The report proposes to define a scientific field that discovers issues for social problem resolution using scientific methods as science for discovery of "social wish," in addition to cognizing science and designing science, and promote them as consilience, so that science could contribute to resolve social problems as well as develop sustainably for itself[11]. The report points out the importance of consilience in DRR, referring to "If 'consilience' which could respond to social requests had already come to realization, scientists could have provided information required to prevent or get over the complex catastrophe caused by mega earthquakes and tsunamis, severe accidents of nuclear power plants and harmful rumors in the Great East Japan Earthquake and Tsunami which occurred on March 11, 2011." [11, pp.1-2] It also recommends to develop "consilience knowledge base" as a basis of consilience and cultivate and increase human resources who can promote consilience.

Representing an entire body of researchers who engage in all scientific fields ranging from humanities/social sciences, life science to natural science/engineering (hereinafter called the scientific community), SCJ has been discussing the importance of universal viewpoints and comprehensive and multifaceted visions as well as the framework and methodology for consilience since the beginning of this century, as mentioned above. "Regionology" that promotes consilience for specific regions has also been proposed. Internationally, Future Earth, a new international collaborative research program, has been carried out since 2014 with the recognition of transdisciplinary research approach that engages all stakeholders in an entire research framework, not limiting to the scientific community's efforts. Researches on global environment change were conducted through four international research programs (Global Environment Change: GEC). In former times, while the programs contributed to deepen scientific knowledge, they were criticized for not

promoting social transformation. In response to the criticism, reviews were conducted through trial and error with discussions on how to promote integrated research with cooperation between the four programs. As a result, Future Earth has been established through the merger of three programs, led by the International Council for Science (ICSU) and the International Social Science Council (ISSC), both of which represent the scientific community, as well as research funding agencies and relevant United Nations organizations.

Future Earth promotes interdisciplinary-transdisciplinary research toward a sustainable planet. In Future Earth, researchers from wide-ranging fields and various stakeholders (from international agencies, national/local governments, funding agencies, industrial communities, the media and NGOs/NPOs) share practical issues which are rooted locally, co-design and co-produce research and co-deliver the results to understand and resolve global environment problems. Transdisciplinary research has also been strongly promoted in Japan. The government of Japan provides Future Earth with financial contributions. The scientific community in Japan, led by SCJ, builds a network with stakeholders in the country and plays an active role in the Future Earth Secretariat.

In parallel, the integration of international scientific organizations advanced. In 2017, both the ICSU and ISSC that respectively administered natural science and social science were integrated to form the International Science Council (ISC).

4. Initiatives toward a sustainable, resilient, global society

(1) Initiatives through international development policies

For 20 years since 1991, international cooperation agencies have supported development projects in the world totaling some three trillion dollars. However, only 100 billion dollars, accounting for approximately 3% of the total, was invested on DRR projects. Breakdown of the spending shows that two-thirds were spent for emergency response after disasters, while only 13% was for prior DRR investment. As for donors, funding from the government of Japan and the World Bank accounted for more than half of all funding for DRR, which indicates that numbers of international development organizations were not fully engaged in DRR. Although DRR had not always been treated as a main subject in international development policies, necessity of mainstreaming DRR has been emphasized through the Sendai Framework in 2015 and integrated into the 2030 Agenda[12].

As for recent activities by international organizations, the United Nations Development Programme (UNDP) leads major activities for each of SDGs with the objective to achieve “sustainable development taking account of disaster risk.” For example, UNDP promotes measures for DRR and climate change as a key element for poverty eradication under the Goal 1 “End Poverty,” and supports activities such as mainstreaming climate risk management in gender-oriented development plans, developing comprehensive disaster policies and their legislation, as well as building early warning systems[13]. Furthermore, the UNDP and the International Research Institute of Disaster Science (IRIDeS), Tohoku University, worked together to establish the Global Centre for Disaster Statistics in Tohoku University after the third UN World Conference on DRR in 2015. The Centre aims to function as a hub for collecting and analyzing disaster information as well as to play a role of compiling DRR expertise and technical assistance.

As for the government of Japan, the largest donor in international assistance on DRR, the Cabinet approved “Development Cooperation Charter” in 2015, which articulates the

need to realize inclusive, sustainable and resilient “growth with high quality” by evolving the concept of “human security.” [14] Japan’s development cooperation is to be conducted based on this policy, and it is necessary to support solving international development issues and achieving sustainable growth, based on the experiences/knowledge and lessons/technologies acquired.

(2) Scientific Initiatives

Integrated Research on Disaster Risk (IRDR), an international science program, was initiated in response to a fundamental question: “Why are loss and damage caused by disasters not reduced amid science and technology development?” [15] With the objective of reducing disaster loss and damage with scientific actions, the IRDR conducts research on how science should be used for decision-making processes on disaster reduction, operating working groups on detecting disaster causes, understanding risk and actions, and data on disaster loss and damage, the Center of Excellences (COE) as well as national committees.

Future Earth deals with “sustainable rural areas,” “sustainable consumption and production,” and “governance for a resilient society” as main themes, in addition to themes such as water/food/energy, carbon, natural assets, urbanization and health. Future Earth has also initiated the “Knowledge-Action Network (KAN),” which performs cross-sectional studies. The KAN is examining how to elaborate the linkage between Environment/Development and DRR, dealing with disaster risk reduction under environmental changes, on top of themes such as sustainable fiscal/financial system and consumption/production.

In recent years, the concept of “Ecosystem-based disaster risk reduction (Eco-DRR)” has been advocated worldwide. It promotes to maintain ecosystems and ecosystem services (benefit from ecosystems) to function as buffer zones/materials against natural hazards as well as to support residents and local communities in their response to natural disasters based on the ecosystems’ function of supplying food and water.

The European Commission has established the Disaster Risk Management Knowledge Centre (DRMKC） to support EU member countries in their disaster response and risk reduction. In 2017, the DRMKC published “Science for DRM 2017: knowing better and losing less,” which is a synthesis report focusing on how to implement scientific knowledge for disaster risk reduction [16]. The DRMKC will publish the report periodically and is currently drafting the version for 2020.

Japan promotes a science and technology policy of the Society 5.0, which is defined in “The Fifth Science and Technology Basic Plan.” Its concept is to create unprecedented value by 1) building a cyber-physical system (CPS) that integrates virtual spaces and physical spaces, 2) integrating and analyzing an enormous amount of information obtained through various censors that are connected to the Internet, and 3) sharing various information and knowledge nationwide. As an example in the DRR field, the Cross-ministerial Strategic Innovation Promotion Program (SIP) promotes building CPS for DRR designed for the national government and local governments as well as conducting research and development and its implementation of using satellite constellation to support the CPS to realize the Society 5.0 in times of a disaster.

As for the activities by research institutes, the International Earthquake Engineering Training, initiated by the Institute of Industrial Science of the University of Tokyo in 1960,

has been running for 60 years to develop human resources who can contribute to earthquake and tsunami disaster reduction in the world. After being conducted as a joint program by the government of Japan and the United Nations Educational, Scientific and Cultural Organizations (UNESCO), this training is currently run by the Building Research Institute in cooperation with the Japan International Cooperation Agency (JICA) and the National Graduate Institute for Policy Studies (GRIPS). Internationally, the Global Alliance of Disaster Research Institutes (GADRI), organized by 204 research institutes on disasters and DRR worldwide, shares information, knowledge, experiences, and principles to contribute to the enhancement of disaster risk reduction and disaster resilience from a scientific perspective. Domestically, the Alliance of DRR Research, established in March 2019 by 14 research institutes and a private sector platform, promotes integrated research, comprehensively combining cognizing science and designing science in the DRR research field and incorporating science for discovery on "social wish." After the Great East Japan Earthquake and Tsunami, SCJ and 58 scientific societies on DRR established the Japan Academic Network for Disaster Reduction (JANET-DR) to promote interdisciplinary cooperation. The Network serves as an emergency contact in case of a large-scale disaster and swiftly/timely disseminates integrated scientific knowledge by press conferences and emergency messages through inter-field cooperation. It also fosters integrated understanding on disaster phenomena through holding symposiums to share research results.

(3) Initiatives by Science Council of Japan to reduce disaster risk and strengthen resilience

Compiling various concepts and approaches comprehensively in cooperation with the international community, SCJ contributed to the formulation of the Sendai Framework and elaborated effective implementation measures.

- "Building Resilience to Disasters of Natural and Technical Origin" [17], a joint statement by the G8 summit countries and academies of relevant countries (May 2012): it urged summit countries' leaders to reduce disaster risk through incorporating resilience strategies into their national plans and development assistance plans.

- SCJ organized the Tokyo Conference on International Study for Disaster Risk Reduction and Resilience in January 2015 and announced the contents of discussions to the international community through the "Tokyo Statement" and "Tokyo Action Agenda," which has led to integrate the importance of science and technology in the Sendai Framework. [3]

- Recommendation: Disaster Risk Reduction and Promotion of International Research on Disaster Prevention and Mitigation – Recommendations for Implementation of the Sendai Framework for Disaster Reduction and Tokyo Statement. [4] To implement the results of the Tokyo Conference and the third UN World Conference on DRR, this recommendation articulated collaborative actions, implementing entities, and practical measures by countries to reduce disaster risk using from science and technology perspectives.

- G-Science Academies Joint Statement, “Strengthening Disaster Resilience is Essential to Sustainable Development” (April 2016) [18]: Actions toward implementing the Sendai Framework have been proposed, understanding that global frameworks such as the Sendai Framework, the 2030 Agenda and the Paris Agreement on Climate Change were adopted, and strengthening disaster resilience is the pre-condition to support sustainable development.

- G-Science Academies Joint Statement, “Cultural Heritage: Building Resilience to Natural Disasters” (May 2017) [19]: Concrete measures have been proposed to integrate protection of cultural heritage with existing DRR policies.

- InterAcademy Partnership (IAP) statement, “Science and Technology for Disaster Risk Reduction” (November 2017) [20]: Cooperative international actions have been proposed toward building a society more resilient to disasters.

- Tokyo Resilience Forum (November 2017): “Tokyo Statement 2017” proposed to produce, in cooperation with all stakeholders, guidelines on national DRR platforms with contribution of science and technology as well as periodic synthesis reports.

5. “Consilience” desired : A recommendation of basic concepts and concrete actions

(1) Concept of integration of DRR and Environment/Development

Disaster resilience and sustainable development are closely inter-related. To address the issues of both areas, it is necessary to understand their contents in a comprehensive manner, study their root causes thoroughly, and conduct planning/implementation/evaluation for resolution. Actions are required to understand the issues correctly and produce new value through practice of learning and improvement.

To strengthen disaster resilience, it is necessary to enhance the capabilities of forecasting, prevention, and response through the following measures:

- to share common understanding on underlying disaster risk drivers, and improve accuracy of forecasts,
- to take preventive measures including social infrastructure development, improvement of land use and housing design, and evacuation drills, and,
- to prepare for actions on disaster occurrence so that we can protect our lives by absorbing disaster impacts, continue livelihoods and businesses for swift recovery, and achieve Build Back Better with due consideration of existing issues in society.

To this end, continuous risk communication between local stakeholders and specialists engaged in DRR is indispensable at an ordinary time.

Development activities, originally expected to enhance human security, may hinder it through underlying risk drivers such as population explosion, expansion of economic disparity, lack of social justice, unstable governance, unplanned land use, and environmental degradation. These risk drivers are deeply linked with social vulnerabilities, exposure to hazards, and lack of disaster response capacities. As reducing disaster risk is often emphasized in poverty eradication, disaster risk is one of the elements that hinder the achievement of SDGs; therefore, both are closely interlinked. Hazards, through their impact to geophysical zones and the biosphere, cause not only direct damage to livelihoods and productive activities in urban and rural areas, but also indirect damage

through disruption or decrease of water, energy and food supply as well as through loss of education opportunities and labor markets. Hazards bring poverty and degrade social justice and peace to an enormous extent. However, for example, it has not been fully verified how disasters exacerbate poverty in developing countries, nor how much in quantity DRR has contributed to poverty eradication and social and economic development. In other words, deeper scientific understanding is necessary in the mechanisms of poverty aggravation by disasters and poverty reduction through DRR. Without such understanding, it is impossible to achieve sustainable development taking account of disasters and to build a resilient society. Development of integrated research on DRR and Environment/Development will enable us to not only reduce disaster loss and damage but also design more effective DRR measures and investment, which can contribute to poverty eradication and social and economic development in developing countries.

As mentioned above, disaster resilience and sustainable development are closely and structurally interlinked through risk. DRR is explicitly stated in several targets of SDGs. Recent trend of international discussions clearly indicates that strengthening disaster resilience is a major premise for sustainable development, and integration of both initiatives should be promoted. To support these discussions and lead them to concrete decision making, it is necessary to promote consilience that circulates knowledge by integrating cognizing science and designing science and forming a network with social actors through science for discovery of “social wish,” as per SCJ recommendation. This approach is in line with the basic principles of Future Earth, which promotes transdisciplinary research where the scientific community and society work together.

Consilience in DRR and Environment/Development should be conducted in a comprehensive manner on-site where various issues arise. The term “on-site” as used herein covers a variety of target areas of different scales. As explicitly defined in the HFA and the Sendai Framework, national governments have the primary responsibility for DRR. Likewise, considering how localized disaster risk can be, responsibilities for DRR lies in a wide variety of actors ranging from local governments, companies, organizations to communities and residents. Therefore, every target that each actor, from resident to a nation, tackles with should be recognized as on-site. Considering the issues such as climate change and tsunami propagation, impacts to supply chain networks and disaster immigrants, the scale of on-site goes beyond national borders and expands to regional and global scale.

On-site stakeholders from national government, local governments/companies/organizations, communities, and residents should recognize risk on disasters and Environment/Development in an integrated manner and share them widely and then take actions in accordance with each on-site situation. To this end, on-site stakeholders and the scientific community should communicate with each other sincerely on a regular basis, take a holistic view of related data and information as well as other practices/issues in their mother tongue, and draw ideal pictures and design actions to be taken in a comprehensive manner. These actions lead to provide integrated scenarios to enhance disaster resilience and promote sustainable development based on scientific knowledge. This whole process is hereby named “synthesis.”

On-site stakeholders, however, see challenges in leaving their areas and acquiring information of their non-professional subjects; therefore, they have difficulty in making

decisions and taking actions to resolve issues on-site based on a multilateral analysis. In many cases, exertion of each actor's creativity is limited and fostering of "zest for living" is hampered, and sustainability is not improved. To resolve this challenge, as SCJ highlights in "Proposal toward 'consilience' as science for society," [11] it is necessary to develop "consilience knowledge base" and cultivate and increase human resources who can promote consilience. This Recommendation defines the base as "Online Synthesis System (OSS) for the Promotion of DRR and Sustainable Development" and the human resources as "Facilitators." Although a Facilitator is considered just as "a master of ceremony," this Recommendation defines it as "catalytic beings who has functions to moderate meetings, lead to resolve problems and provide professional advices on-site."

(2) Development of the Online Synthesis System (OSS) for the Promotion of DRR and Sustainable Development

Achieving consilience in DRR and Environment/Development is challenging.

SCJ proposes to develop "consilience knowledge base," a dynamic system that can perform simulation to resolve social challenges and promote consilience at the same time. "Consilience knowledge base" should not be just a search engine term. First, it should have a function to assist users with their integrated understanding by providing them with opportunities where they can access the knowledge of science across disciplines and beyond the confines of cognizing science and designing science. Second, it should also be equipped with a function to promote collaboration between on-site stakeholders and the scientific community by incorporating "social wish," which is necessary to identify and resolve problems. Therefore, it is necessary to introduce advanced simulation methods, knowledge modelling technologies and human interface technologies with proactive participation of researchers. The base should also facilitate dialogue between on-site stakeholders and the scientific community about disaster resilience and SDGs and be utilized for their synthesis activities on a regular and continual basis. This Recommendation aims to develop the OSS on the internet as the system which has a function of "consilience knowledge base" by connecting various data and information transmission systems via information networks and by integrating cyber spaces and physical spaces in an advanced way based on the concept of Society 5.0. Moreover, it also aims to enhance the ability of decision making, investment and response utilizing integrated knowledge produced through the OSS and the ability of identifying the truth/falsity and making judgements (called "literacy") as well as the intention to act. In short, the OSS is defined as the upper system to connect various data and information transmission systems.

The OSS is required to have a function for users to explore, collect, archive and search, in their mother tongues, scientific information on achievement and future plans of the four priorities for action stipulated in the Sendai Framework and the targets in the 2030 Agenda as well as information on experience including good practices and lessons learned from all over the world and basic information on legal systems and policies. To this end, it is indispensable to cooperate with international scientific organizations, various on-site stakeholders, and UN/international agencies. It is also required to enhance the OSS's function for data search and integrated usage by designing, registering, and sharing while developing metadata, which describes data types, characteristics, qualities, and acquisition methods, by international standards. To resolve the issue of interoperability

incurred by the difference in definitions of technical terms in a variety of related fields, it is required to systematize framework concepts of how to define terms in each field or across fields and to describe them for general use (called development of ontology).Furthermore, the OSS should enhance risk communication capability by data integration, information fusion, prediction and simulation, and their visualization. Mutual information exchange and dialogue between on-site stakeholders and the scientific community should also be realized and activated by the OSS.

The OSS is also required to be equipped with the functions to coordinate challenges and efforts being conducted in various disciplines towards consilience as well as to meet a wide range of new needs from citizens, municipalities, countries, regions and the world. Therefore, it is essential to internalize a structure where the OSS will be advanced, extended and developed as system developers, network institutes and users deepen their cooperation with obtaining requests for improvement and information provided proactively from networks of institutes and users(called ecosystem).

In the field of disaster research, there are many issues to be addressed, including international agreement on metadata structure through developing a list of technical terms, establishment of a sustainable function to collect, store and integrate information across a wide variety of subjects, and promotion of dialogue between the science community and society. To overcome these challenges, a favorable methodology of developing OSS would be; first create a relatively simple and small prototype, then widely share the merits and expand the prototype gradually, in cooperation with several entities with advanced and high literacy on information disclosure. In the development of OSS, it is expected that science communities lead at first and decision makers and on-site practitioners as well as all stakeholders participate in the process, which in turn the OSS will evolve into synthesized and sustainable system everyone can constantly contribute and utilize as a result.

(3) Fostering “Facilitators” who support the development and management of OSS

A general approach to resolve a problem would be: actions encouraged to conduct planning/action/evaluation for resolution by identifying the problem clear as a gap between what it should be and what it is and then by capturing it properly through investigation of its causes. To enhance disaster resilience in the context of achieving SDGs, it would be necessary to encourage on-site stakeholders to express their various ideas and opinions while respecting their own initiatives, experiences and expertise and make transactive processes through dialogues for effective and useful problem resolution. As a result, we would be able to change our behaviors as necessary in times of a disaster by making decisions based on scientific knowledge, taking into account various information to resolve problems on-site, and by internalizing values and norms through incorporating them into our own values, not limited to compliance to existing norms and regulations and conformity to local values.

To achieve the above, an external support function is required to assist on-site stakeholders to discover and share on-site needs and awareness of the problems, building a relationship of trust with them, as well as to facilitate them to find, obtain, understand and utilize a variety of information for problem resolution. A function should also be equipped to assist them to understand where the problems are and what they are as well as to provide them, based on scientific knowledge, with options of the measures

to resolve the problems, goals to be achieved, and governance structure to implement selected measures. Moreover, an ability is required to provide explanation to convince on-site stakeholders, and a capacity to supervise the process of problem resolutions by on-site stakeholders in a responsible manner. Also, an ability to disseminate good practices and success/failure stories to other locations as lessons learned, and to learn from others, are required. We call those who are equipped with all these capacities, “Facilitators.”

The basic abilities necessary for Facilitators are to develop creativity that fosters self-reliance in problem resolution, conduct science-based thinking, perform facilitation functions of moderating meetings, stimulate problem resolution, provide professional advice, understand and advocate SDGs, bring out the capability of local residents to resolve their own problems on-site and disseminate the success stories as lessons learned to other locations. As SCJ’s 21st term Recommendation “Toward ‘consilience’ as science for society” [11] stated, Facilitators are those who engage in science for discovery of a “social wish” to be established in addition to cognizing science and designing science. Facilitators can be cultivated and increased only when the science community makes an effort to properly evaluate the scientific and social value of science for discovery of “social wish.”

As the Recommendation insisted, “consilience knowledge base” is necessary for these activities. The role is also expected to develop a system which enables cognizing science, designing science, science for discovery of “social wish” and society to form partnership, co-exist & co-prosper, through circulating scientific knowledge and experiences (circulating system of consilience) by reflecting on-site stakeholders’ needs on the development of OSS functions as well as by effective utilization of the OSS.

To design a way to promote disaster resilience and sustainable development in an integrated manner (called “integrated scenario”), we need to have an integrated view covering both areas. Facilitators grow along with the development of the OSS and play a role to translate new knowledge produced by the OSS and disseminate them in a timely and appropriate manner. Through providing advices to on-site stakeholders utilizing OSS’s knowledge, in normal times, Facilitators help develop a resilient and sustainable society; in times of a disaster, they contribute to overcome the crisis, so that society can foresee further crises, understand them properly, minimize the impacts and effects and recover from the crisis by Building Back Better .

However, at present, only a limited number of professionals can achieve these functions. The reason is because scientists tend to specialize only in their own area of expertise; they are seldom given chances to become a person with a holistic view. Training opportunities to gain techniques and attitudes to enhance their skills for on-site implementation are limited. Considering the pressing need to develop and perform integrated scenarios toward the target year 2030 of both the Sendai Framework and SDGs’, the scientific community bears a grave responsibility for cultivating Facilitators who have an integrated view that disaster resilience is a premise of sustainable development.

6. Recommendations from science for a sustainable, resilient, global society

With the understanding that strengthening disaster resilience is a major premise for achieving the goals of sustainable development, it is necessary to promote development of integrated scenarios for DRR and Environment/Development and execute concrete measures according to them in cooperation with a wide range of stakeholders. Therefore,

we recommend the following actions:

Recommendation 1: The scientific community should develop the Online Synthesis System (OSS) to promote DRR and Sustainable Development.

To support enhancement of synthesis for strengthening disaster resilience and promoting sustainable development, the scientific community should develop the Online Synthesis Systems (OSS) under interdisciplinary cooperation with international scientific organizations, various on-site stakeholders and UN/international agencies. The OSS should be equipped with functions for users to explore, collect, archive and search in various languages, scientific information as well as information of experiences, including good practices and success/failure stories, shared from all over the world and basic information on legal systems and policies. The OSS should also have functions to integrate these data and information, conduct forecasts and simulations, facilitate effective risk communications through visualization, and establish information exchange and dialogue among stakeholders. The OSS should be functional in each mother tongue so that it will be used in each country under international cooperation.

Recommendation 2: The scientific community should foster Facilitators.

Knowledge, experiences and methods suitable for their location should be provided and external experiences and resources should be effectively introduced so that on-site stakeholders can in an inclusive and participatory manner enhance disaster resilience and sustainable development, effectively taking advantage of the OSS and based on integrated scientific knowledge. To do so, Facilitators are required to assist stakeholders who effectively apply science and technology, protect their lives and assets and continue their livelihoods and businesses. Therefore, the scientific community should foster Facilitators in collaboration with local universities, disaster research centers and scientific institutions and in mutual cooperation with society.

Recommendation 3: On-site stakeholders, in cooperation with Facilitators and effectively taking advantage of the OSS, should develop integrated scenarios for DRR and Environment/Development and execute concrete measures toward enhancement of disaster resilience and achievement of SDGs.

On-site stakeholders and the scientific community should take collaborative actions, with effective utilization of the OSS and support from Facilitators, by sharing the understanding of disaster risk through every dialogue, forming a cyclic system of consilience, discovering the relationship of causes and effects between DRR and Environment/Development scientifically, and deepening quantitative understanding. Above all they should clarify the effects and roles of DRR in achieving SDGs and reflect them on their activities.

Recommendation 4: International scientific organizations, UN/international agencies and international aid agencies should support the development of the OSS, Facilitators and integrated scenarios for each country and region to take actions.

International and regional scientific organizations should accelerate activities of scientific communities in countries in terms of knowledge sharing on science and

technology and designing information base. UN/international agencies and international aid agencies should establish a system to assist countries to raise awareness on the above, and develop and manage the information base in the context of improving quality and effectiveness of assistance in DRR and Environment/Development fields.

4.1 Roles of international communities

- Define and position the roles of the OSS and Facilitators in building a sustainable, resilient, global society and invite countries to implement the contents of this Recommendation in UN resolutions and other international statements.
- Call for implementation of recommended items in this document at the UN Global Platform for DRR and the UN High-Level Political Forum on Sustainable Development (HLPF). Monitor and share the progress of the implementation with the international communities.
- Promote international cooperation on DRR such as the development of international agreements on aid and cooperation for DRR, disaster response and recovery.
- Urge and support establishment of an international mechanism to integrate DRR and Environment/Development and execute measures collaboratively.
- Integrate the 2030 Agenda and the Sendai Framework through, e.g., incorporation of the Sendai targets into SDGs.

4.2 Roles of International and regional scientific organizations （ISC, Future Earth, STAG, IRDR, GADRI, SCA, etc.）

1) Organize workshops to share understanding and practices on interdisciplinary-transdisciplinary challenges with the scientific communities in each country.
2) Fulfill functions as international deliberative committees to provide advice on the interoperability of the information base (including multi-language function, design, registration and management of metadata, and development of Ontology) as well as on the operation of the OSS.

4.3 Roles of the UN/international agencies and international aid agencies (UNDRR, UNDP, UNESCO, WMO, UNU, IFIs, government donors, etc.)

1) Develop measures to enhance interests and motivations in conducting synthesis with the OSS in each country.
2) Aiming at achieving targets of the Sendai Framework and SDGs, assist countries, from a professional point of view, in their development of roadmaps based on their synthesis and in implementation of concrete actions, and provide them with funds.

References

[1] UNDRR: Sendai Framework for Disaster Risk Reduction 2015-2013, 2015.
https://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf

[2] United Nations: Transforming our world: the 2030 Agenda for Sustainable Development, 2015.
https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

[3] UNISDR, ICSU/IRDR, SCJ, University of Tokyo: Tokyo Statement 2015, 2015.
http://wci.t.u-tokyo.ac.jp/events/TokyoConference2015/en/pdf/Tokyo.Statement_Action.Agenda.pdf

[4] Science Council of Japan, Subcommittee for the Tokyo Conference on International Study for Disaster Risk Reduction and Resilience, Subcommittee for IRDR, and Committee for Civil Engineering and Architecture: Recommendation: Disaster Risk Reduction and Promotion of International Research on Disaster Prevention and Mitigation – Recommendations for Implementation of the Sendai Framework for Disaster Reduction and Tokyo Statement
（原題）提言「防災・減災に関する国際研究の推進と災害リスクの軽減―仙台防災枠組・東京宣言の具体化に向けた提言―」, 2016.
http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-23-t225-1-en.pdf (English)
http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-23-t225-1.pdf (Japanese)

[5] UNISDR, ICSU/IRDR, SCJ, PWRI, NIED: Global Forum on Science and Technology for Disaster Resilience 2017, 2017.
http://wci.t.u-tokyo.ac.jp/ResilienceForum2017/

[6] UNDRR: Global Platform for Disaster Risk Reduction Co-Chairs' Summary "Resilience Dividend: Towards Sustainable and Inclusive Societies",
https://www.preventionweb.net/files/58809_chairsummary.pdf, p.4, 40paragraph.

[7] UNDRR: The Means Necessary - A stakeholder declaration to the 2019 Global Platform for Disaster Risk Reduction,
https://www.preventionweb.net/files/64878_finalgpdrr2019shdeclaration.pdf

[8] United Nations: Report of the Secretary-General on SDG Progress, 2019.
https://sustainabledevelopment.un.org/content/documents/24978Report_of_the_SG_on_SDG_Progress_2019.pdf

[9] Science Council of Japan, Management Council, Committee on new Science System: New Scientific System–Integration of Social and Natural Sciences for Society–
（原題）日本学術会議運営審議会附置新しい学術体系委員会：新しい学術の体系 –社会のための学術と文理の融合–, 2003.
http://www.scj.go.jp/ja/info/kohyo/18pdf/1829.pdf (Japanese)

[10] Science Council of Japan, Management Council, Committee on Scientist Community and Consilience: Proposal: Integration of Knowledge - Towards Science for Society –
http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-20-t34-2e.pdf (English)
（原題）日本学術会議運営審議会科学者コミュニティと知の統合委員会：対外報告「提言：知の統合 –社会のための科学に向けて–」, 2007.

http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-20-t34-2.pdf (Japanese)
[11] Science Council of Japan, Committee on Consilience as Science for Society : Recommendation toward ‘consilience’ as science for society
（原題）日本学術会議社会のための学術としての「知の統合」推進委員会：提言「社会のための学術としての「知の統合」－その具現に向けて－」, 2011.
http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-21-t130-7.pdf (Japanese)
[12] Jan Kellett and Alice Caravani: Financing Disaster Risk Reduction, 2013.
https://www.gfdrr.org/sites/default/files/publication/Financing-DRR_Publication_0.pdf
[13] UNDP: UNDP Support to the Implementation of Sustainable Development Goal 1, 2016.
https://www.undp.org/content/dam/undp/library/Sustainable%20Development/1_Poverty_Jan15_digital.pdf
[14] Ministry of Foreign Affairs (Japan): Development Cooperation Charter, 2015.
https://www.mofa.go.jp/mofaj/gaiko/oda/files/000072774.pdf
[15] International Council for Science: A Science Plan for Integrated Research on Disaster Risk: Addressing the challenge of natural and human-induced environmental hazards, 2008, ISBN 978-0-930357-66-5.
[16] Disaster Risk Management Knowledge Centre: Science for disaster risk management 2017 - knowing better and losing less-, 2017.
https://op.europa.eu/en/publication-detail/-/publication/4bc0e055-3712-11e7-a08e-01aa75ed71a1/language-en
[17] Science Council of Japan, G-Science Academies Statements 2012: “Building Resilience to Disasters of Natural and Technological Origin”
（原題）「自然災害および技術的災害に対するレジリエンス（回復力）の構築」, 2012.
http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-22-s1j.pdf (Japanese)
[18] Science Council of Japan, G-Science Academies Statements 2016: “Strengthening Disaster Resilience is Essential to Sustainable Development”
（原題）「持続可能な発展を支える災害レジリエンスの強化」, 2016.
http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-23-gs2016-2j.pdf (Japanese)
[19] Science Council of Japan, G-Science Academies Statements 2017: “Cultural Heritage: Building Resilience to Natural Disasters”
（原題）「文化遺産：自然災害に対するレジリエンスの確立」, 2017.
http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-23-gs2017-3j.pdf (Japanese)
[20] InterAcademy Partnership (IAP): Statement 2017 "Statement on Science and Technology for Disaster Risk Reduction", 2017.
https://www.interacademies.org/statement/statement-science-and-technology-disaster-risk-reduction

＜Appendix 1＞ Deliberation Process in the Committee on International Cooperation for Promoting Science-Based Disaster Risk Reduction

2017

November 2 — 1st Meeting: Election of board members, discussion on the process, preparation and proceedings of the Resilience Forum, and the Statements for IAP DRR

2018

January 5 — 2nd Meeting: Briefing on the Resilience Forum and preparation for the 2019

March 2 — 3rd Meeting: DRR Science and Technology Synthesis and the Guideline for the National Platform

June 29 — 4th Meeting: Reports on the past activities and future work

October 13 — 5th Meeting: Promotion of Nation's Synthesis

2019

March 22 — 6th Meeting: Reports on the past activities and future work

2020

January 29 — 7th Meeting: Deliberation on the Recommendation (draft outline and skeleton)

March 19 — 8th Meeting: Deliberation on the Recommendation (draft outline)

April 24 — 9th Meeting: Deliberation on the Recommendation (draft outline)

<Appendix 2> Roles of Facilitators in building disaster resilience

This appendix is a committee discussion note of the original roles of Facilitators and the backgrounds of Facilitators in DRR and sustainable development.

1 Building disaster resilience is required “on-site” aiming to achieve sustainable development goals.

Disaster risk reduction (DRR) is not explicitly listed as one of the 17 goals for sustainable development, or SDGs. However, increased disaster resilience is the very foundation to ensure sustainable development. In fact, among the 169 targets of the 17 SDG goals, six targets claim that SDGs cannot be realized unless either vulnerability to disasters is reduced or resilience to disasters is strengthened. More specifically, disaster resilience is directly linked to the following five SDG goals: 1. No Poverty, 2. Zero Hunger, 11. Sustainable Cities and Communities, ris13. Climate Action, and 14. Life Below Water (searched by “disaster” or “resilience”).

Goal 1. No Poverty

By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters. (1.5)

Goal 2. Zero Hunger

By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters, and that progressively improve land and soil quality. (2.4)

Goal 11. Sustainable Cities and Communities

By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations. (11.5)

By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans toward inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels. (11.b)

Goal 13. Climate Action

Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all

countries. (13.1)

Goal 14. Life Below Water

By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans (14.2).

In the “site” where efforts are being made toward the realization of SDGs, strengthening resilience to disasters is closely intertwined with the issues of sustainable development, and thus a holistic view which integrate DRR and sustainable development is required to create effective solutions. The “site” is the place where problems interrupting sustainable development exist and where people facing such problems exist. In other words, the “site” is exactly where people need to learn and make changes to solve problems and take action to create new values.

2. Facilitators are indispensable for the “site” in making efforts toward the realization of SDGs.

In a system capable of solving problems sustainably, the following three actions should be encouraged: 1) Understand the problem accurately; 2) Find out the causes of the problem correctly; and 3) Practice planning, implementation and evaluation cycles for the sake of solving the problem.

Facilitators are those outside catalysts who can help problem-solving in the “site”. They are able to elicit different new views and ideas from each local participant while understanding local participants’ position as the primary actors in the problem-solving and respecting their experiences and expertise. They also work to maximize the interaction among participants in discussions toward the solution to the problem. In total, Facilitators help local participants work out problems, create, realize and learn new ideas and perspectives, deepen mutual understanding, and enhance information sharing.

Originally, Facilitators started to be used in three different settings: 1) group learning, 2) local revitalization, and 3) business practice. [2]

Group learning was first introduced in the 1950s as a training method for people to learn about interpersonal relationships. In such programs, there were those people who helped each participant as well as the group as a whole to develop necessary skills and attitudes to have a good relationship with others, and they were named Facilitators. The practice still continues in experiential learning and other educational situations that need facilitation.

At about the same time, the participatory community development started in the United States, where workshops and facilitation started to be systematically organized as a new approach to discussing community issues at community development centers (CDC). The approach is still used today in participatory community development.

In businesses practice, Facilitators were not so common until they were first introduced in the

1970s, also in the United States, as a method to have meetings more efficiently. This approach was later called “workout” when applied to bottom-up operational reform by a team specifically formed to the mission. Today, facilitation is recognized as a professional skill, and businesses often have Facilitators when holding an important meeting. They have recently started to be seen as supporting-type leaders.

Soon Idea that use Facilitators came to Japan and was used and studied in various disciplines. Once accepted, facilitation in Japan developed into a unique style, such as the community development efforts in Setagaya Ward, Tokyo. In business settings, quality-control leaders played precisely the same role as Facilitators, even when people had no idea about what Facilitators were. Unfortunately, in Japan, facilitation failed to be regarded as a professional skill, and even the word “Facilitator” itself was hardly recognized for decades, except in some international companies.

Around the beginning of the 21st century, some businesses started to show interest in facilitation, and many books on the topic began to hit the shelves of bookstores. Universities opened new graduate-level courses specifically to focus on facilitation, as it increasingly drew attention academically. Finally facilitation became a familiar concept in Japan.

Today, it is a common practice that the workshop-style approach with facilitations for efficient, productive discussions are recognized as important techniques to integrate interdisciplinary knowledge acquired from natural science and social sciences to construct a new social system [3]. They are also regarded as a “social skill” necessary to solve current and future problems in society that have or may have a direct impact on society.

Workshops as a social skill are not only used to form a consensus among participants but also to solicit commitment in each participant in the problem-solving process [4]. Since this function of workshops should be significantly useful to increase resilience to disasters, the workshop approach has been employed in many projects around the world, including the development of a disaster risk reduction plan in Otsuchi Town, Iwate Prefecture, Japan, and the development of a reconstruction plan after 9/11 terrorist attacks in the United States.

In order to achieve SDGs, which address universal issues, it is essential to involve all people, regions, and organizations around the world. However, each “site” has its own uniqueness having different problems requiring different solutions. Thus, it is important to produce and support Facilitators so that they can assist people in each “site” in continuing their efforts to solve local problems there. In this respect, Facilitators are expected to: 1) be present on-site, 2) elicit the ability to solve local problems on-site from local people, and 3) disseminate good practices at one “site” to another.

At present, the science community cannot provide enough number of Facilitators, due to its narrow scientific expertise, which makes it difficult for them to develop a holistic view needed for Facilitators. It is also difficult because they have few opportunities to develop such skills and attitudes in practicing their expertise which can be transferred as explicit knowledge at educational settings. It is urgent to train and support those experts who could play the role of Facilitators with a good understanding of

disaster resilience as the foundation of sustainable development.

3. Roles of Facilitators with OSS

To increase resilience to disasters, it is essential to strengthen the resilience of every individual who has the commitment to contribute to sustainable development. This ability can be realized when the following basic requirements are met: 1) People are provided with clothing, food, and shelter and are in good physical condition, and 2) They have opportunities to demonstrate their own creativity and be recognized for it [6]. One can demonstrate their creativity in the process where they can make their judgments and decisions independently to implement them in society. The more individuals are successful in increasing their creativity to cope with disasters, the more they become capable of helping themselves, which then positively affects their ability to promote mutual-help, and finally strengthens society's overall resilience to disasters.

Reasonable judgments can be possible when people are able to make one independently on-site, based on a wide range of information about the "site". In reality, people tend to know a lot about where they live and what they are interested in, but they do not necessarily know much about a wider world outside theirs. Our Online Synthesis System (OSS) can help them overcome this weakness by offering them access to a great variety of science-based information in their own tongue.

At the same time, it is too early to say that the general public understands the importance of the relation between DRR and sustainable development. To promote awareness of general public, various initiatives including legal measures may be necessary to be employed to achieve those goals. Resulting changes in individual behavior can be categorized into the following three different levels:

Level 1. Compliance with social norms, laws and regulations: People changes their overt behavior but not covert beliefs.

Level 2. Conformity to a certain value system: People changes their overt behavior due to the influence of the group to which they belong.

Level 3. Internalization of certain values and social norms: People behave in such way as they believe in certain values and social norms into their value system.

It is urgent to increase resilience to disasters to achieve sustainable development. As a premise for this, it is needed to be accepted voluntarily by every individual values and norms related to disaster resilience to internalize them as a part of their value system. Neither compliance nor conformity is simply not enough. In order to internalize the concept of disaster resilience, it is required to have systematic education through books, journalism, and some other means. Equally important is the activities of Facilitators, who are expected to encourage and support people's voluntary acceptance and internalization of values and norms related to disaster resilience.

Facilitators for DRR/Sustainable development are expected to not just an ordinary Master of Ceremony, but they play an important role in the consilience of DRR/Sustainable development as

described in this policy recommendation, which defines the Facilitator as catalysts on-site with capabilities of facilitating meetings, streamlining problem-solving processes, and offering expertise. More specifically, Facilitators for DRR/Sustainable development are expected to play the following eight different roles for their success: 1) Identify and delineate an on-site problem by showing the gap between the ideal state and the current state; 2) Analyze the causes of the on-site problem and support local stakeholders in sharing the same understanding of the problem; 3) Make maximum use of OSS to access various types of data and information for problem solving; 4) Brief the local implications of data and information that are useful to solve the problem; 5) Assist local stakeholders in understanding the causes and structure of the problem, based on scientific evidence; 6) Suggest possible goals, possible solutions, and governance styles to implement problem solving; 7) Support local stakeholders involved in the problem solving to make their own decisions and to form a consensus in the way they can all be satisfied; and 8) Support the implementation process to fulfill their responsibilities in achieving promised goals.

Facilitators are also expected to contribute to the integration of intelligence in the following four areas: 1) Interpret and disseminate the knowledge and information stored in OSS to be useful to solve on-site problems; 2) Feedback the findings and approaches practiced on-site. In case of disasters, using all available information stored in OSS to build disaster resilience; 3) Minimize the impact of a disaster on sustainable development in societies by maximizing the power of prediction (predicting the development of a disaster scientifically), prevention (preventing the spread of damage), and response (responding to unexpected situations flexibly); and 4) Facilitate the reconstruction of social infrastructure and contribute to building communities back better.

4. The science community should proliferate Facilitators.

One way that science can contribute to realize a sustainable, resilient international community is to send Facilitators, as the translator and mediators of science-based skills and approaches that are useful to solve problems, to the ”site”, where people engage in protecting lives and property and safeguarding the continuity of livelihoods and businesses. In this sense, it is essential for Facilitators to have a good understanding of the effective use of science and technology and be able to use a database of scientific evidence efficiently through OSS, so that they can fulfill their responsibilities, applying evidence-based approaches. The science community should create a training system to proliferate Facilitators substantially in collaboration with local universities, disaster research centers, and academic societies. The training should be organized for trainees to develop the following abilities: 1) the ability to nurture creativity with which to help local stakeholders develop their ability to solve problems by themselves; 2) the ability to think based on scientific evidence; 3) the ability to practice facilitation as a combination of facilitating meetings, streamlining problem-solving processes, and offering advice based on their expertise; 4) the ability to understand SDGs; and 5) the ability to communicate the outcome of their activities to others.

OSS should be a tool that can be easily handled by Facilitators equipped with basic skills and

knowledge, so that the system can provide the basis for them to create an opportunity where local stakeholders can access data and information necessary to solve problems in their own native languages and practice a standardized facilitation consistently. In the development and management of OSS, improvements should be made continuously, based on feedback from Facilitators around the world. To this end, stakeholders worldwide should cooperate in every possible way imaginable.