An Overview of Research on Disaster Environment

Towards Recovery and Restoration from Disasters and Environmental Creation

April 2012

National Institute for Environmental Studies

Foreword

Recovery from the Great East Japan Earthquake of March 11, 2011 is of pressing urgency for Japan as a whole. The earthquake and tsunami brought great destruction to the social infrastructure, including both material and human losses. It also caused problems for industry throughout the world due to the disruption in the supply chain. In addition, with the pollution arising from the wide-scale release of radioactive substances from the accident at the nuclear plant, many residents were forced to evacuate their homes. Many issues – including the large volume of disaster waste; the unprecedented release of radioactive substances on a scale never before experienced; the recovery of the industrial and social infrastructure; the revival of regional societies lost in the disaster and evacuation – remain to be addressed. Japan as a whole must, with the world's help, come to grips with these issues.

Recovery from the disasters means remaking both a healthy society and the natural world – that is to say the creation of a regional environment in a broader sense. On top of seeking to attain an accurate grasp of the actual circumstances of the disaster-stricken area's regional environment and an impact assessment of the damage to it, we should create a safe and secure society. If we are to address the vast and composite damage caused by disasters, we must integrate and connect wide and diverse fields and researchers, and should also aim for intimate ties with the various cores of activity throughout society.

NIES is implementing a variety of post-disaster research, such as that which aims at: clarification of the human health effects; assessment of biological and ecosystem impacts; addressing regional contamination; management of disaster waste; facilitating and expediting regional and societal recovery which allows for environmental conservation; and environmental risk management. This diversity in the research being undertaken is aimed at aiding recovery efforts by those directly impacted by the disaster; government and regional authorities; and the many citizens groups. NIES must elucidate an overall picture of these various research strands to the world; it must also share the research concepts surrounding restoration, such as "environmental creation", with society. Environmental creation is a new concept which refers to the process of constructing from scratch an environment which is resilient to future impacts, in cooperation with the community.

This booklet provides a panoramic overview of the various research themes which are currently being implemented at NIES towards recovery and environmental creation in the wake of the Great East Japan Earthquake as "Research on Disaster Environment". It has been structured in such a way as to provide a multilateral and user-friendly grasp of the possibilities

for mutual tying-up and expansion on research fronts, and the interconnection of research outcomes. In addition to the research already underway, this endeavor also points the way towards the essential new research areas of the future. For a variety of researchers, this document clarifies and positions their particular research themes. For those responsible for the administrative aspects, and for the public, it is hoped that the booklet will provide an opportunity to understand how the essential issues are linked with these themes and how they should be resolved by means of the know-how and technical outcomes of this research.

In its capacity as the leading Japanese institution for environmental research, NIES has a duty to schematize the entire picture of such research. This booklet was made with the participation of experts taken from the wide field of specializations at our institute. Because it is an undertaking which has at its core the research being implemented at NIES, this places the booklet in a foundational position in the creation of an overall picture of Research on Disaster Environment. A future theme will be to give a similar panorama for research being carried out between Japan and other institutions across the globe.

I would be delighted if “An Overview of Research on Disaster Environment” contributes to recovery from the Great East Japan Earthquake, and environmental creation for the disaster zone. Hereafter, with the cooperation of other universities and research institutions, we wish to further enhance and legitimate Research on Disaster Environment. This will surely depend on the cooperation and support of everyone concerned by the issues here described, a wide range of stakeholders and institutions, and indeed the public at large.

April 2012

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Table of Contents

Part One

In Part One, Chapter One, a panoramic depiction of Research on Disaster Environment is created by organizing the environmental themes which must be elucidated and resolved into their respective fields. In Part One, Chapter Two, the multifaceted aspects, which cannot be encapsulated in an organizational chart, are summarized as a precept for the mobilization of Research on Disaster Environment.

Chapter One: Panorama of Research on Disaster Environment

When we created "An Overview of Research on Disaster Environment" (April 2012 version), we firstly decided to depict this overview in the form of a structure diagram in which the whole could be comprehended. We organized this into the panorama which accompanies this booklet (Figure 1)* in order to make this as comprehensive as possible, from the standpoint of those themes which need to be elucidated and resolved.

As can be comprehended from the panorama in Figure 2, a large amount of research activities are closely associated. These are classified into the two overriding themes necessitated by the disaster zone and called "Understanding of actual circumstances and impact assessment for the environment" (Part Two, Chapter One), and "Disaster recovery and the creation of a safe and secure society" (Part Two, Chapter Two), in order to position individual research activities. "Understanding of actual circumstances and impact assessment for the environment" is made up of the group of themes relating to the elucidation of effects on human health; the assessment of effects on biology and ecosystems; and dealing with regional contamination.

"Disaster recovery and the creation of a safe and secure society" is made up of the group of themes relating to disaster waste management; regeneration of regions and society allowing for environmental conservation; and environmental risk management. It is further organized into sub-topics as depicted in detail in Figures 3 to 8, as a means to connect the various topic groups and research groups.

With a panoramic depiction of this kind, the strategic positioning of research strands is made clear in a user-friendly manner, and we can thus anticipate that research will be more readily understood by society. Moreover, it was necessary to panoramically depict the entire structure from an integrated viewpoint, such that the most effective and efficient use of the limited research resources may produce optimum and readily usable research outcomes.

* This panorama was made using the FreeMind software (http://freemind.sourceforge.net/wiki/index.php/Main_Page), and is intended for publication on the National Institute for Environmental Studies webpage, etc. (http://nies.go.jp)

Figure 1: *Panorama of Research on Disaster Environment* (Framework)

Legend (applicable from figure on following page)

- *Research topic currently underway*
- *Research for information provision*
- *Research to be undertaken after 2012*
- *Research being undertaken in cooperation with other institutions*
- *Research topic which should be undertaken*

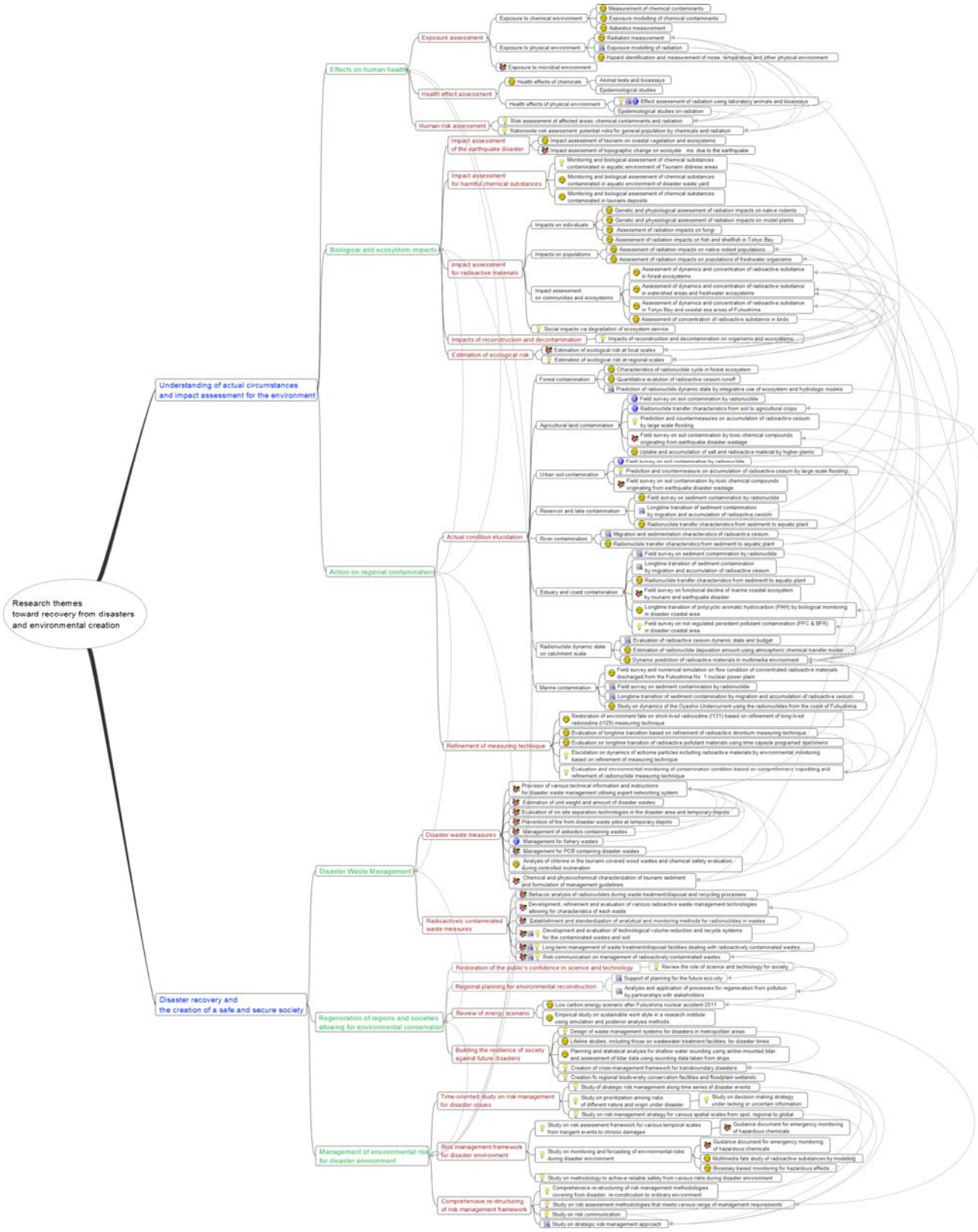

Figure 2: *Panorama of Research on Disaster Environment* (Complete Overview)

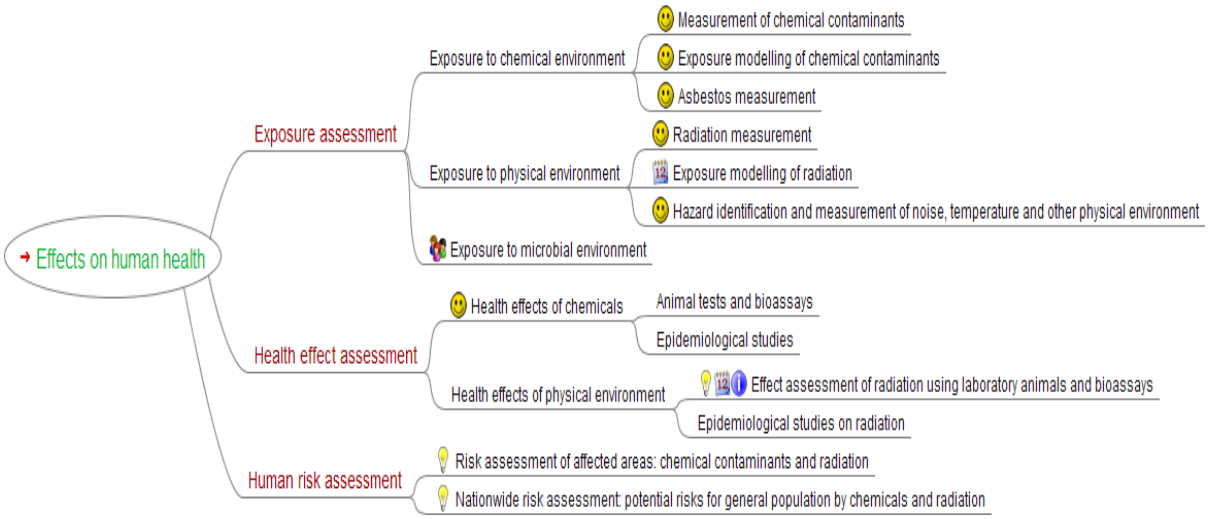

Figure 3: *Research on Disaster Environment* (Effects on human health)

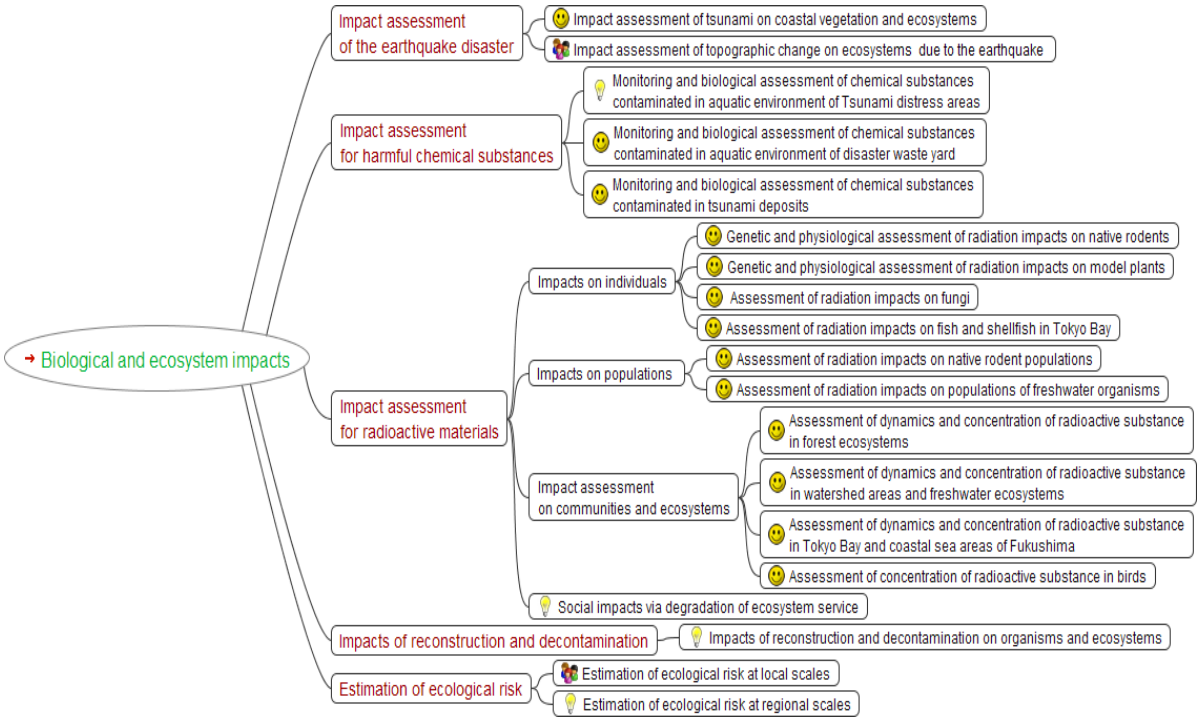

Figure 4: *Panorama of Research on Disaster Environment* (Biological and ecosystem impacts)

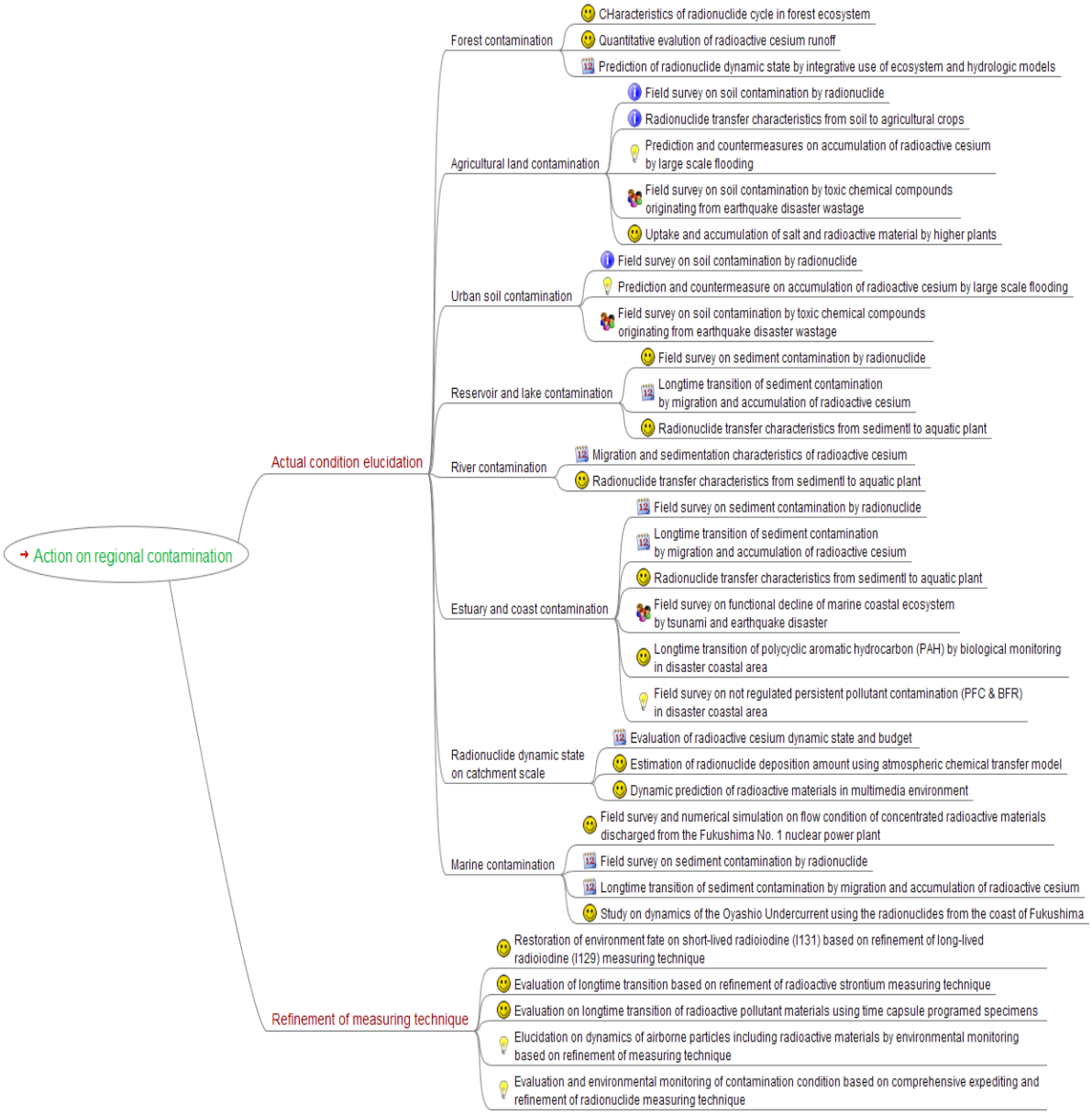

Figure 5: *Panorama of Research on Disaster Environment* (Action on regional contamination)

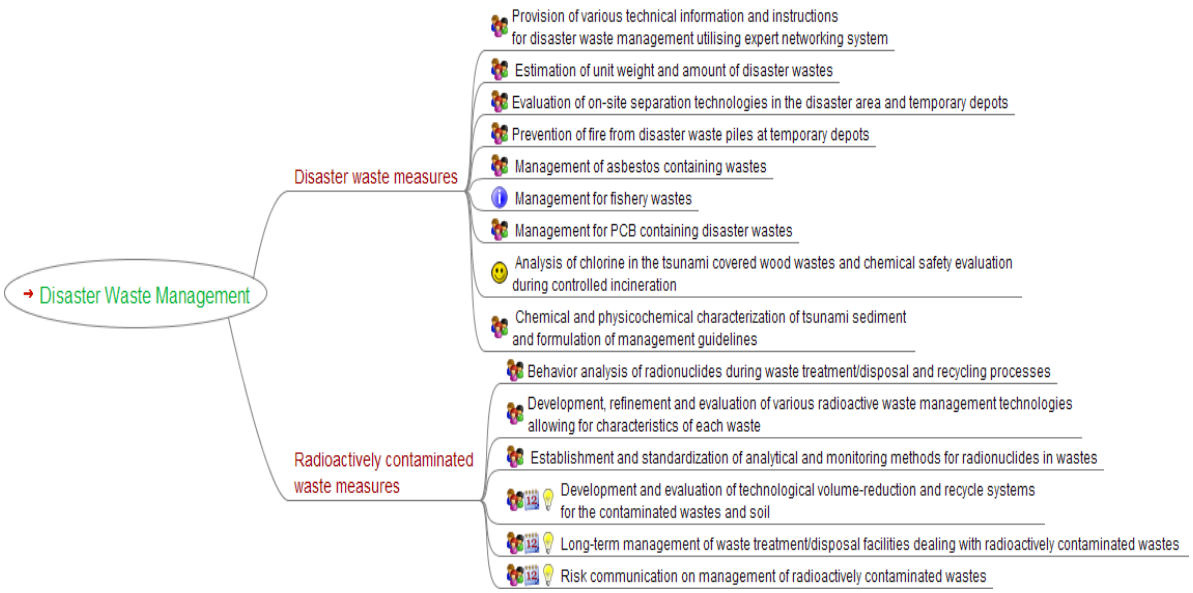

Figure 6: *Panorama of Research on Disaster Environment* (Disaster Waste Management)

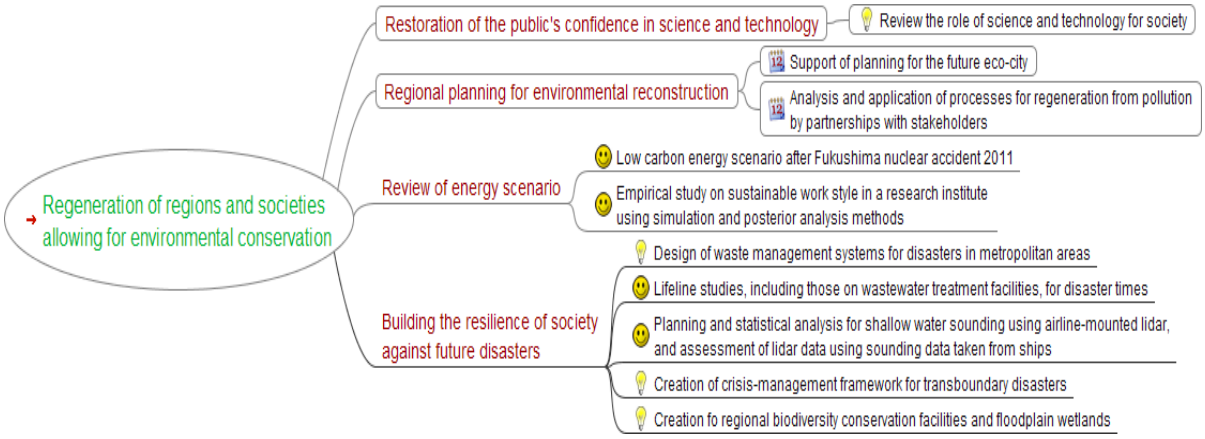

Figure 7: *Panorama of Research on Disaster Environment*

(Regeneration of regions and societies allowing for environmental conservation)

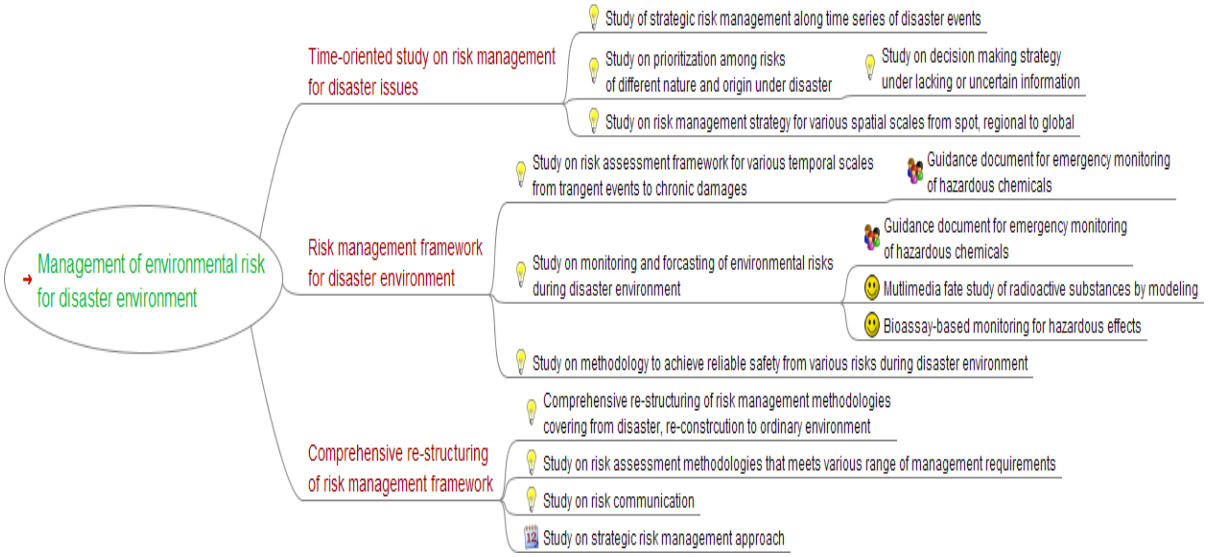

Figure 8: *Panorama of Research on Disaster Environment*

(Management of environmental risk for disaster environment)

Chapter Two: Towards the development and continuity of Research on Disaster Environment

The facilities of the National Institute for Environmental Studies were themselves damaged in the Great East Japan Earthquake. While addressing the question of restoration of this damage, NIES dispatched as many researchers as possible to the disaster zone, and in a manner as speedy as was feasible. Since then, it has maintained activities both for recovery and restoration. Some examples include the technical issues relating to the management of large volumes of salinized disaster waste from the tsunami; the public health issues posed by dust within the evacuation shelters; and the issue of environmental contamination by radioactive substances – each of which requires precise, speedy and scientific investigations and solutions. We were able to achieve a direct grasp of the situation in the disaster zone by means of these activities in the immediate aftermath of the disaster. While working out the essential themes for recovery and restoration, and those which necessitated considerable specialized knowledge in order to be addressed, we carried out activities to solve the most pressing emergency issues and mitigate any future damage. We also put forward various proposals by means of different scientific societies and the Science Council of Japan, etc., as well as issuing directions to the central government and local authorities in the stricken areas, as the need arose.

NIES have maintained an awareness of the necessity to understand the environmental issues which are still in the process of emerging in the wake of the 2011 off the Pacific Coast of Tohoku Earthquake and the accident at the TEPCO Fukushima Daiichi Nuclear Power Plant. We are also sensitive to the necessity to test the effectiveness of the approaches and policies pertaining to the removal and reduction of damage in the wake of the disaster. Themes such as the impact on ecosystem services of removal activities - closely bound to the medium to long term renewal of regions - or those such as the prompt treatment of disaster waste towards restoration are here to the fore. For these themes, NIES researchers from a variety of environmental fields cooperate in providing their expertise. Along with anticipating potential environmental issues, they are striving to understand and elucidate the areas of concern and propose equivalent measures and procedures for their resolution.

We have learned many lessons from environmental research on the large scale, complex and composite disaster that has come to be known as the Great East Japan Earthquake. In this booklet we have summarized and shown these lessons towards the furtherance of Research on Disaster Environment.

1. Necessity for development of time-oriented research in the aftermath of disasters

Research on Disaster Environment must maintain an awareness of its development as being in step with temporal changes in circumstances. In the direct aftermath of the disasters occurrence, we achieve an initial grasp of the situation and then observe the circumstances in accordance with the scale of the disaster and of the damage. Subsequently, we ascertain the causes of any issues, while also identifying any particular

“causes for concern”. We also predict which damage has the potential to lead to further issues. We then propose and implement the measures and procedures to the problems which have already occurred while putting together proposals to prevent the actualization of the issues associated with the previously mentioned “causes for concern”. To achieve this, we use models and simulations, and then make monitoring proposals based on their outcomes.

It is also necessary to develop disaster waste management policies; to make projections for environmental pollution allowing for regional characteristics; to research on protective measures for human health; to research on control technologies relating to recovery and restoration; and to research on measures for environmental creation. Finally we must periodically test the effectiveness of the approaches and policies, and find improved methodologies.

2. The importance of normal-period observations

We reaffirmed the importance of normal-period observations in the process of implementing disaster environment research. When evaluating the environment at times of disaster, it is not uncommon to find that there are no nominative indicators or values for certain matters. In these circumstances it is essential to compare current data with the monitoring data from normal periods. Also, when disasters occur, they are followed by various phases - from the actual occurrence; life-saving and rescue; to lifeline recovery and restoration - and we can assume that there will be an equivalent level of divergence in the associated environmental issues. Accordingly, long-term and continuous studies, which allow for these various processes, are necessary in environmental research at the time of disasters. The maintenance of such regular long-term scientific research is not without complications. This has reconfirmed the importance of one of the foremost missions of the National Institute for Environmental Studies - to cooperate with national and local regional authorities and regional environmental research institutions etc., to collect observational data during normal periods - as part of the implementation of long-term environmental studies for the recovery process.

3. Groundwork for a prompt response

In order to cater to unforeseen circumstances, it is necessary to have provisions in place during normal periods. The reason we were able to show a degree of flexibility in responding to disaster waste and contamination from radioactive substances from the current disaster is because we were able to make use of the fruits of research and methodologies gained from the regular research in relation to the management of toxic materials; the development of appropriate disposal methods; and atmospheric pollution simulations.

On the other hand, it is also extremely important as a research institute to have anticipatory procedures for responding to the various kinds of disaster which might be foreseen (earthquakes; tsunami;

contamination by radioactive substances; large scale fires; chemical and oil spills, etc). One of NIES' most fundamental missions is to make clear the impacts on humans and ecosystems which accompany a deterioration of the environment due to disasters, and to put forward proposals towards the mitigation of those impacts. Our research activities are implemented in line with this basic ideal, and by having an understanding of the available resources during normal periods, we are able to respond in a flexible manner to the ground-level situations during times of emergency.

4. The importance of diverse and multilateral links

Disaster environment contains genuinely complicated and compound phenomena. Moreover, each of these phenomena is related to the others. They also have associations with the many and varied fields of science and technology. It is thus necessary to build links which transcend the various research fields and academic disciplines. Also, to ensure that the research outcomes are used speedily and effectively on the ground, close ties and unity - between ministries and agencies responsible for the administrative aspects, and between national bodies and regional authorities, and between the administration and private enterprises and NGOs - are key. The effectiveness of the practical application of science and technology to society is strongly questioned at the time of disasters.

5. Records and dissemination

The importance of recording was reaffirmed by the advent of the Great East Japan Earthquake. The recording and storage of the details of widespread and varied damage is of essential importance - for disaster environment; for the recovery and restoration process; and for the development of environmental creation. Indeed, this booklet may be thought of as part of these records. The earthquake-related research currently being implemented, and the records of previously-completed scientific research (for example the Great Hanshin Earthquake, the Nakhodka Tanker Incident, etc.) are of great importance towards ongoing environmental creation and preparedness for the future. Despite the importance of records and database creation, it is sometimes the case that these endeavors are not given their due in academic circles. It is necessary to have a structure for the accurate evaluation and support of such database creation for the whole country.

Also, these records must be made public over an appropriate time frame and in an appropriate form. In relation to the current earthquake, there were indications from abroad that the level of dissemination of information from Japan was insufficient. The transmission of accurate information in a timely manner is essential for our modern internationalized society. NIES has conveyed its research outcomes to the world, and will continue it's Research on Disaster Environment - such as studies on issues like environmental pollution from disasters or the spread of radioactive substances, both of which have become a global reality - in

cooperation with research institutions from countries throughout the world.

6. Leadership and the cultivation of human resources

Thanks to our improved know-how and technology, many counter-measures are being taken in response to the various kinds of disasters which might be foreseen - cooperating on the drafting of a crisis response manual, making this known, and putting it into practice. However, disasters are by their very nature unforeseeable, and when they do occur it is not the existent manuals and technologies, but the specialized fields and leadership at all levels which become essential. In the process of executing pioneering environmental research which maintains an awareness of the realities on the ground, NIES cultivates researchers who can act as leaders in both national and global fields. It is these researchers who will contribute to the future resolution of environmental issues at times of disaster.

[NOTE: The remainder of the document is currently available in Japanese only]

This version of "An Overview of Research on Disaster Environment" is accurate and up-to-date as of April 2012. We plan to attempt to keep the overview up-to-date in line with the progress of recovery and the development of research.

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