

Expanding the Scope of Environmental Emergency Research towards Disaster-resilience and Environmental Sustainability

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Abstract

Climate change is already showing its influence in natural disasters and is likely to exacerbate natural disasters in the future. Given these circumstances, the results of and experience in research on disasters and the environment should facilitate the creation of a sustainable, disaster-resilient society. In this regard, systematic consideration of the knowledge gained from environmental emergency research conducted since the Great East Japan Earthquake would help establish a new research field based on disaster-related environmental research of the past. Here, we propose a conceptual framework for expanding the scope of environmental emergency research towards disaster-resilience and environmental sustainability.

Key words : disaster resilience, environmental emergency research, Great East Japan Earthquake, natural disasters, sustainability

1. Introduction

In recent years the sustainability of society has been impaired by environmental problems resulting from sudden-onset natural disasters. The Great East Japan Earthquake (GEJE) and the subsequent tsunami in 2011 that caused the Fukushima Daichi nuclear power plant accident (hereinafter the “nuclear accident”) is one such example. The accident released radioactive substances that caused environmental pollution and necessitated the removal of large amounts of radioactive waste and contaminated soil. Since then, major natural disasters have occurred almost every year with great impacts on society and the environment. The existing academic discipline of environmental science is inadequate for addressing these circumstances. A new knowledge system for environmental issues is needed that unites the accumulated environmental knowledge from environmental emergency response, disaster recovery in the disaster prevention/mitigation and sustainable community development. A new approach is necessary in the present age when knowledge from “normal times” is inadequate for dealing with the various large-scale disasters, accidents and sudden-onset situations, such as the global COVID-19 pandemic, that are occurring. Such an approach can be developed further into “discontinuity science” and “non-steady-state science” for seamlessly linking normal times and states of emergency.

2. Disaster-related Environmental Research in Japan

2.1 Summary of Disaster-related Environmental Research in Japan before the GEJE

Up to now in Japan, environmental issues and disasters have been addressed in research as separate issues in terms of environmental protection measures and disaster prevention/mitigation. There were two main impetuses that led to the launching of a movement in the early 2000s to address these issues simultaneously (National Institute for Environmental Studies, 2013). The first was the 2nd Science and Technology Basic Plan (Government of Japan, 2001), which stressed the importance of research on river basin management in harmony with nature. Based on this plan, technological development was conducted to link disaster prevention/mitigation measures with fundamental ecosystem services (such as hydrological cycle control) and regulatory services (such as natural disaster control) in river basin management. The second impetus, based on experiences of the 1995 Great Hanshin-Awaji earthquake, 2004 Niigata Chuetsu earthquake and 2004 Sumatra-Andaman earthquake, stemmed from the view that environmental infrastructure and disaster prevention/mitigation projects, both falling under the category of social infrastructure development, could be implemented more efficiently if carried out together and, furthermore, could contribute to

local community development. For example, the Japan Society of Civil Engineers (2006) report titled *Technology and System Coordination for Environmental and Disaster Prevention* lays out the impacts of natural disaster prevention measures on the environment, and conversely, the impacts of environmental measures on disaster prevention. The report stresses the importance of coordination between the two.

2.2 Disaster-related Environmental Research after the GEJE

After the GEJE, a wide range of research on the disaster was carried out by newly-formed organizations including the Tohoku University International Research Center of Disaster Science, Fukushima University Institute of Environmental Radioactivity, Waseda Resilience Research Institute, and Fukushima Prefectural Centre for Environmental Creation, as well as existing organizations such as the Kyoto University Disaster Prevention Research Institute and Nagoya University Disaster Mitigation Center, which had been conducting disaster prevention and mitigation research prior to the GEJE. However, while much research has been conducted from the perspectives of disaster prevention and resilience, few studies have addressed post-disaster reconstruction and community development. Also, environmental perspectives have not always been adequately addressed.

As the papers included in this special issue show, many studies have addressed environmental emergency aspects including post-disaster environmental impacts of pollutants, environmental recovery and management of disaster wastes (e.g., Iijima *et al.*, 2020). With regards to the nuclear accident caused by the GEJE, a wide range of research has been conducted and many results have already been reported on the environmental impacts of the large amounts of radioactive substances released into the environment (Science Council of Japan, 2020). These environmental emergency studies have made a major contribution to reconstruction efforts and environmental recovery in areas affected by the GEJE and nuclear accident. In addition, research on sustainable community development, including the establishment of sustainable regional environments, environmentally conscious reconstruction and the creation of disaster resilient regions is being carried out to some extent, as evident from the papers included in this special issue (e.g., Hirano *et al.*, 2020; Otsuka *et al.*, 2020; Gomi, 2020; Togawa *et al.*, 2020). However, much less research is being conducted in these areas on the environmental impacts, environmental recovery and management of disaster wastes. Given the progress toward reconstruction of the disaster areas, further research is needed, especially in the nuclear disaster-affected areas of Fukushima Prefecture.

Furthermore, systematic research is needed to address the series of processes for increasing the

resilience and sustainability of society during normal times, achieving the mitigation and appropriate management of environmental impacts during disasters, and accelerating the transition to sustainable society through environmental recovery.

3. Conceptual Framework of the New Research Field for Disaster-resilience and Environmental Sustainability

3.1 Necessity and Aim of the New Concept

In recent years, frequent large-scale natural disasters have occurred with substantial impacts on the environment. There is a high risk that the frequency of disasters will increase due to the accelerating impacts of climate change. The existing disciplines of environmental science and environmental engineering are inadequate for addressing these circumstances. A new body of knowledge on environmental issues is needed for integrating the knowledge gained on emergency response and disaster reconstruction through disaster science. However, as laid out in Chapter 2, while such research has been conducted to some extent, this research has not been organized within a theoretical framework. In particular, up to now, the conceptual framework and methodologies that seamlessly link different phases—from preparation for disaster resilience during normal times to systematic emergency response immediately following a disaster, rapid environmental recovery and development of a sustainable society in the medium to long-term—have not been explored either in Japan or abroad.

Given the frequent occurrence of various disasters, to have science contribute to the building of a sustainable, disaster-resilient society, a new research field needs to be established that can systematize the knowledge and experience accumulated through disaster response and contribute scientifically to the creation of a sustainable, disaster-resilient society. This research field would be defined as a body of knowledge with the objective of achieving sustainable societies in the long term by improving the sustainability and resilience of societies during normal times, achieving mitigation and appropriate management of environmental impacts during disasters, and using disaster reconstruction to improve sustainability further.

Tajima and Osako (2020) organized environmental impacts of disasters into four categories: (1) disturbances of the natural environment, (2) generation of disaster wastes, (3) release of toxic chemical substances and (4) environmental impacts associated with disaster recovery and reconstruction. The purpose of the disaster-resilience and environmental sustainability research field will be to systematize the knowledge related to the mitigation and management of the above environmental impacts associated with disasters.

3.2 Methodology

In addition to the aspects addressed by conventional environmental emergency management such as the mitigation and management of environmental impacts associated with disasters, it is important for the new research field to aim to improve the sustainability and disaster-resilience of societal systems during normal times, use disaster reconstruction to increase sustainability, and promote cycling and interrelationships between these three phases. Although there are various arguments regarding whether it is possible to achieve both sustainability and disaster resilience based on existing general principles proposed for accomplishing these two goals simultaneously (Redman, 2014; Elmqvist et al., 2019), the methodology for the disaster-resilience and environmental sustainability research field can be laid out by phase in a timeline from before to after disasters as shown in Fig. 1.

(1) Simultaneous improvement of sustainability and disaster resilience of social systems during normal times

Research to facilitate smooth implementation of environmental impact management during disasters, research on improving sustainability through disaster reconstruction, and research on environmental impact mitigation during disasters.

(2) Environmental impact management during disasters

Research on the overall management of the series of processes from the identification of pollution sources and assessment of impacts to emergency measures to mitigate impacts and treatment and disposal of pollution sources.

(3) Increasing sustainability by transforming social structures through reconstruction

Projects and community development utilizing local

environmental resources to ensure sustainability in the recovery and reconstruction process and research to resolve environmental, social and economic issues existing in communities prior to disasters as part of regional disaster reconstruction.

It will be important to establish the new research field in collaboration with various stakeholders in disaster areas and to accumulate and systematize specialized knowledge and experience through the lateral transfer of research results to non-disaster areas.

4. Summary

There is a high risk of natural disasters increasing in the future due to the accelerating impacts of climate change. Given these circumstances, it is necessary to contribute scientifically to the building of a sustainable, disaster-resilient society based on the results from and experience gained through research on disasters and the environment. This report proposes a conceptual framework for expanding the scope of environmental emergency research towards disaster-resilience and environmental sustainability based on a review of domestic research trends. We plan to discuss and continuously revise our proposal with the input of many stakeholders. We hope that this paper will stimulate lively discussions towards the establishment of a new research field for disaster-resilience and environmental sustainability.

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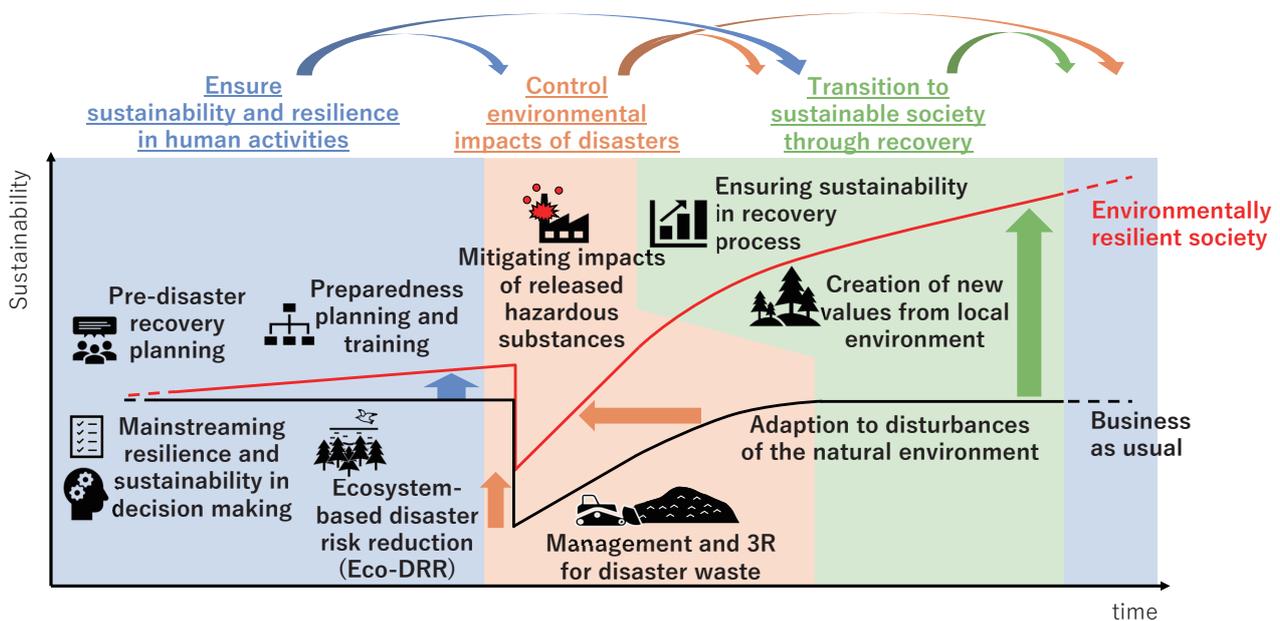


Fig. 1 Outline of research areas for achieving a sustainable and resilient society.

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