Chapter 14
Ecosystem-Based Approaches Toward a Resilient Society in Harmony with Nature

Kazuhiko Takeuchi, Naoki Nakayama, Hiroaki Teshima, Kazuhiko Takemoto, and Nicholas Turner

Abstract Ecosystem-based approaches have proven effective and efficient in reducing disaster risks while ensuring continued benefits to people from ecosystem services. In this article, a new concept of Ecosystem-based Disaster Risk Reduction (Eco-DRR) for enhancing social-ecological resilience is proposed, based on analysis of several case studies. Field studies in developing countries such as Ghana and Myanmar have shown the benefits of Eco-DRR as implemented by local communities. These projects improve local livelihoods and social-ecological resilience. In Japan, after the massive damage from the 11 March 2011, Great East Japan earthquake and tsunami, ecosystem-based approaches were an important element of the national government's DRR efforts. Analysis of these cases shows that Eco-DRR is a socially, economically and environmentally sustainable tool for DRR that creates new value for a region. It also shows the importance of multi-stakeholder participation in the process of promoting Eco-DRR. It is likely to become even more important in the future, as a means for addressing the increase in disasters resulting from climate and ecosystem change as well as demographic change. The contribution of Eco-DRR to maintaining and restoring ecosystems is particularly valuable for countries where there is reduced capacity for land management, as currently occurring in Japan due to rapid population decline and aging.

Keywords Geophysical and meteorological hazards • 11 March 2011 • Great East Japan earthquake and tsunami • Multi-stakeholder engagement • Social-ecological resilience

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14.1 Introduction

The region around the rim of the Pacific Ocean is situated on the “Ring of Fire”, an area where a large number of earthquakes and volcanic activities occur. Disasters are particularly concentrated in this region, which is home to over 75 % of the world’s volcanoes, and where 90 % of the world’s earthquakes occur (USGS 2015).

According to the Emergency Events Database (Guha-Sapir et al. 2015), the number of disasters and the resulting economic damage around the world have generally been rising over recent decades, although there was a decrease in the early years of the twenty-first century (Fig. 14.1). While the number of geological hazards has remained constant, meteorological, hydrological and climatological hazards are on the rise, and are expected to increase further in the future due to the effects of climate change (IPCC 2014). Meanwhile, the number of deaths caused by natural hazards is on a downward trend. This is believed to be the result of disaster risk reduction (DRR) efforts and enhanced knowledge of natural hazards. In contrast, associated economic losses are increasing drastically, now estimated at USD 314 billion per year in the built environment alone (UNISDR 2015). Moreover, if we look at natural hazard occurrences by region, Asia accounts for an overwhelmingly large percentage in terms of the number of hazards and resulting deaths, as well as the magnitude of related economic losses (Fig. 14.1).

While the “Ring of Fire” carries the threat of calamities, it also brings valuable natural capital or “blessings” of nature such as the scenic beauty of volcanic landforms and plentiful hot springs (Fig. 14.2). However, natural hazards such as earthquakes, tsunamis and volcanic eruptions strike suddenly, causing tremendous damage to human lives and livelihoods. But as well as causing damage, these disasters, depending on their scale and type, can also help provide water resources through rain and preserve biodiversity by disturbing the natural environment and forming vegetation landscapes such as riparian forest floodplain.

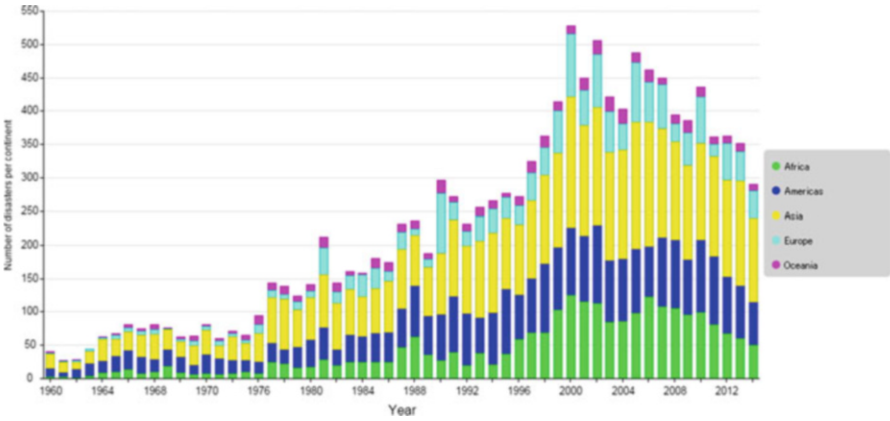

Fig. 14.1 Total number of reported natural hazards from 1960 to 2014 by region (Reproduced from: Guha-Sapir D, Below R, Hoyois P (2015) EM-DAT: International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium)

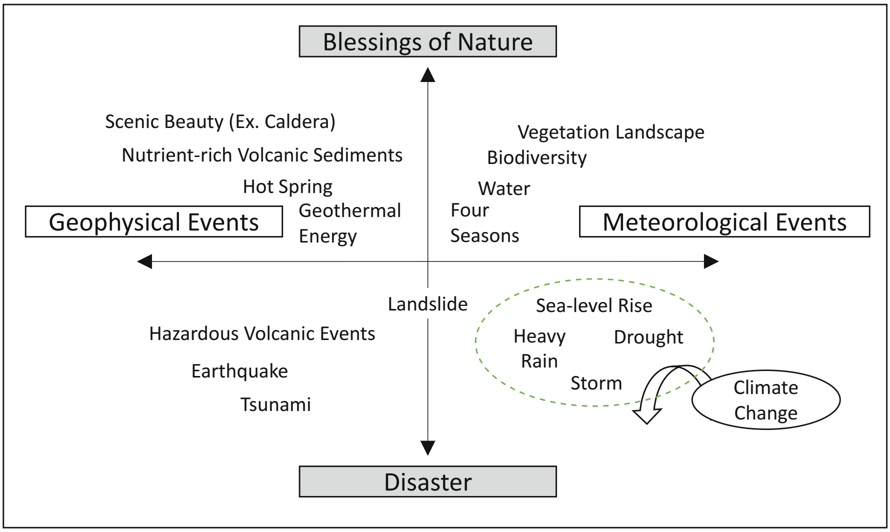

Fig. 14.2 Blessings and threats of nature from natural hazards (Source: authors)

This ambiguity therefore needs to be recognised. The National Biodiversity Strategy of Japan 2012–2020 states that: "Great East Japan Earthquake (GEJE) was an opportunity to recognize once again that nature which provides us with plentiful benefits also becomes a threat on occasion causing disasters and that we have to live with these two opposing characteristics of nature" (MOEJ 2012, p. 2). The strategy, which was revised after the 11 March 2011, GEJE, is based on the vision of approaching nature with a mentality of gratitude and reverence, and achieving a society in harmony with nature by rebuilding relationships between people and nature (MOEJ 2012).

In this chapter, through the analysis of case studies which includes the GEJE, we consider how ecosystems can provide services not only for our daily lives but also for mitigating impacts from natural hazards. We explore how ecosystems can generate new value for communities and enhance social-ecological resilience as a result, and also emphasize how these multiple benefits could be enhanced through multi-stakeholder participation, and through virtuous cycles of supply of and demand for ecosystem services and the return of funds and labor in exchange for these services, which we term the "socio-ecological sphere".

14.2 Eco-DRR for Enhancing Social-Ecological Resilience

Ecosystem-based disaster risk reduction (Eco-DRR) is "the sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim of achieving sustainable and resilient development" (Estrella and Saalismaa 2013, p.30). The ecosystem-based approach is an important tool for building a society in harmony with nature, as it enables us to effectively utilize DRR functions and other blessings of nature.

In Japan after the GEJE, it was recognized that disaster countermeasures including conventional hard engineering were insufficient, and that it was necessary to build social-ecological resilience against future risks and shocks (Takeuchi et al. 2014; Furuta and Seino, Chap. 13). Resilience in this context means "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" (Walker et al. 2004). Based on the concept of Eco-DRR, it is vital to reduce disaster risk while enhancing social-ecological resilience, with the aim of building a resilient society in harmony with nature that can respond flexibly to various natural hazards

Ecosystems can reduce physical exposure to natural hazards such as landslides, floods, avalanches, storm surges and droughts (Sudmeier-Rieux et al. 2013; World Bank 2010). Therefore, in addition to reducing risks related to earthquakes, volcanic activities and tsunamis in the short-term, they are effective in reducing risks of longer-term climate change impacts and increases in hydrological and climatological hazards. For this reason, an ecosystem can contribute to building a social-ecological system for local communities to respond to both short-term and long-term risks in an integrated manner. Lowlands in coastal areas are vulnerable to damage from disasters such as tsunamis as well as sea level rise caused by climate change. DRR measures that take advantage of ecosystems can be particularly useful in this context.

Eco-DRR also contributes both to responding to threats from nature, and to enjoying the blessings of nature. Moreover, it offers further benefits by providing various ecosystem services not only when disasters occur, but also in the reconstruction phase and in ordinary times, contributing to enhancing the resilience of regions and maintaining the livelihoods of people. Nevertheless, since there is a limit to the functions of ecosystem-based approaches, it is necessary to combine and integrate them with various other DRR measures to effectively strengthen the social and economic resilience of regions, as the need for long-term measures is expected to increase. In this way, ecosystem-based approaches can contribute greatly to building a resilient society that is in harmony with nature.

Eco-DRR is not only beneficial in reducing disaster risks; it can also be more cost-effective than conventional approaches (IFRC 2002; Sudmeier-Rieux et al. 2013). It has the additional advantage of providing multiple benefits through ecosystem services. This was evident in southern Louisiana when the region was hit by Hurricane Katrina and the ensuing storm surges in 2005. A study by Wamsley et al. (2009) showed that salt marshes in the area were effective in reducing damage resulting from storm surges caused by the hurricane in inland areas. In addition, it was observed through model simulations that the salt marshes functioned to reduce the scale of the disaster under certain conditions (Wamsley et al. 2009). These DRR effects of the coastal marshes in Louisiana were estimated before Hurricane Katrina to have an annual economic value of USD 940 per hectare (Costanza et al. 1989). With the addition of ecosystem services, this amount increased to USD 12,700 per hectare (Costanza et al. 1997). On this basis, restoring 480,000 ha of marshes led to the revival of ecosystem services providing a value of USD 600 million annually, and a total of USD 20 billion as of 2006 (Costanza et al. 2006). This is a large figure even when compared to the estimated USD 2.5 billion that is required to restore the marshes and repair some embankments, and it demonstrates the positive economic effects of marshland regeneration. We should also note that utilization of the ecosystem is generating new value for the community.

14.3 Multi-Stakeholder Participation and the "Socio-Ecological Sphere"

It is important that local communities participate in the process of promoting Eco-DRR because the maintenance and recovery of ecosystems requires management, and these communities will benefit from various ecosystem services and enhanced social and economic resilience (see also Lange et al.). Also, local communities should take decisions about the future of their regions and choose policies that they will not regret in future. Strengthening the link between local residents and landscapes will contribute to enhancing social-ecological resilience through conservation and restoration of ecosystems (Takeuchi et al. 2014). For example, the participation of local communities is essential for the maintenance and management of the greenbelt of coastal forests. It has also been emphasised that it is crucial to utilise ecosystems so that they contribute to the livelihoods of people in local communities (Shaw et al. 2014).

This idea is similar to the concept of the "socio-ecological sphere" outlined in the National Biodiversity Strategy of Japan 2012–2020, which aims to set up a natural zone of symbiosis, consisting of the supply of and demand for ecosystem services and the return of funds and labor in exchange for these services (Fig. 14.3). "Satoyama" in the Fig. 14.3 is defined as dynamic mosaics of managed socio-ecological systems, which produce a bundle of ecosystem services fo human well-being (Saito and Shibata 2012, p.26). According to this policy, in order to achieve a society that exists in harmony with nature, it is fundamentally important to build decentralized, self-sustaining communities that use and circulate ecosystem services in their regions. But if this faces challenges, we must expand the circulation of ecosystem services to incorporate other areas, including urban areas and other countries, to build relationships between the supply and demand for ecosystem services and the return of funds and labour, which are mutually supportive within these spheres. Although local residents should be at the center of such efforts, a wide range of stakeholders including governments, research and educational institutions, the private sector and non-governmental organizations (NGOs) can help strengthen connections in the socio-ecological sphere by providing resources and support. This concept could be applied to local Eco-DRR activities. To make Eco-DRR activities socially, economically and environmentally sustainable, it is

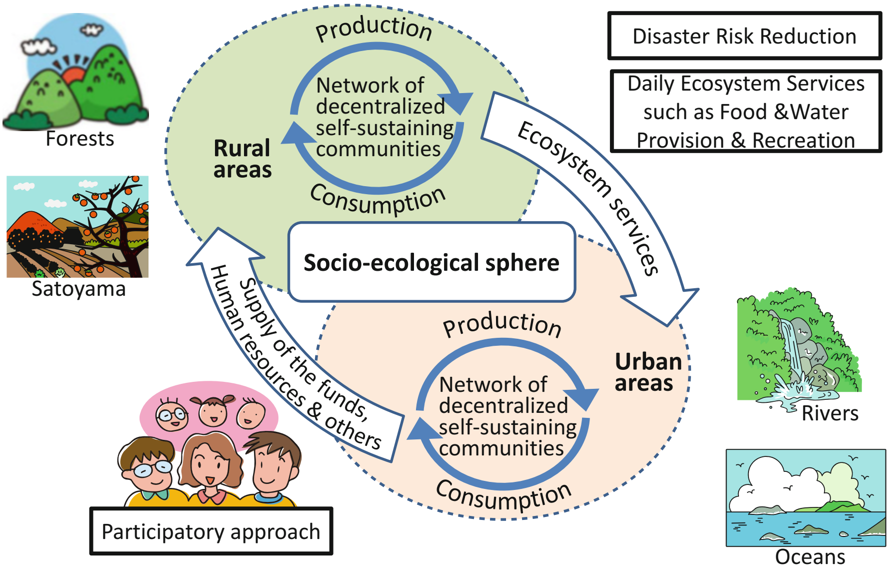

Fig. 14.3 The concept of "socio-ecological sphere" and Eco-DRR (Reproduced and modified from MOEJ 2012, with permission)

important that regions benefiting from ecosystem services contribute human and financial resources to the regions need Eco-DRR.

The following three case studies, from both developing and developed countries, further illustrate how ecosystems have been utilized to contribute to the livelihoods of people in the communities.

14.4 Case Study Analysis

In this chapter, three case studies were selected that provide strong examples of Eco-DRR for both geophysical and meteorological hazards, from sites where the authors have conducted research. The case studies in Ghana and Myanmar focus on meteorological hazards, while the case study of the GEJE deals with the tsunamis caused by geophysical events. At all of these sites, Eco-DRR is closely linked with the daily livelihoods of local communities, creating new value to the regions. Another common feature of these cases is multi-stakeholder participation, which ensures the sustainability of Eco-DRR activities.

14.4.1 Mangrove Forest Rehabilitation and Community Resilience Building in the Coastal Regions of Myanmar

Cyclone Nargis, which devastated coastal regions of Myanmar in 2008, is deemed the country's worst environmental catastrophe. The official death toll in Myanmar from Nargis is 84,537 with 53,836 people still missing, which is 1000 times higher than that from the 2004 Indian Ocean Tsunami in the country (Post-Nargis Joint Assessment – Myanmar 2008). The hardest-hit area was the south-west coast, the Ayeyarwady region in particular. It also devastated the mangrove forests on which people living in the area largely relied upon for their livelihoods. Recognizing this, international and national resources were used to rehabilitate these mangroves and the services they provide to local communities. These services include DRR against storm surges (Post-Nargis Joint Assessment – Myanmar 2008) and contribute to community resilience building (see below). This interrelationship can be considered as an example of the "socio-ecological sphere" illustrated in Fig. 14.3. To build a network of decentralized, self-sustaining communities, the capacity of local communities for sustainable forest management, agriculture and fisheries has been developed through the participation of multiple stakeholders.

The cyclone's impact on the mangrove forests and communities in the region is described in the Post-Nargis Joint Assessment – Myanmar (2008). According to the report, land use conversion had reduced the mangrove area to half of its original size and the clearing of mangrove and other coastal vegetation to create rice fields had increasingly exacerbated the damage inflicted by natural hazards. When Nargis struck, the mangrove forest provided protection to coastal communities (Fig. 14.4), but 38,000 ha of it were destroyed or badly damaged, dealing a massive economic blow to the region, which relies on the forests for livelihoods such as fishing. The report estimated the economic loss associated with the forest's destruction to be USD 4.3 million. The impact of deforestation on local villages is substantial because many of the residents are dependent on the forests for all or part of their livelihoods, and because they use mangrove resources—which involve no monetary transactions—for food and other daily necessities.

To address this issue, a community resilience-building project targeting the region was implemented by the Japan International Cooperation Agency (JICA) with the goal of restoring the mangrove forests surrounding the villages. Efforts were also made as part of the project to identify wind and salt-water tolerant crops and promote use of the region's traditional home gardens. Prior to the project commencing, JICA began working with local villagers in 2002 to develop a master plan for mangrove rehabilitation and launched a technical cooperation project in 2007 based on this plan. The project aimed to enhance the forest management capability of the Myanmar Forestry Ministry and local residents and thereby help restore the forest; it also assisted the villages with recovery from the cyclone's damage. Under this project, JICA, in collaboration with the Myanmar Forestry Ministry and local NGOs, helped plant mangrove trees over an area of 8000 ha after

Fig. 14.4 Mangrove forest and home garden in Ayeyarwady region, Myanmar (Photo: Akira Nagata, reproduced with permission)

the Nargis disaster. In addition, community forest management and agriculture and fisheries revitalization strategies were implemented to improve community livelihoods. These approaches were intended to enhance both DRR and residents' livelihoods through the use of ecosystem services.

14.4.2 Ecological Adaptation to Climate Change and Capacity Building of Villagers in Northern Ghana

The case study of Northern Ghana provides another good example of the "socio-ecological sphere", whereby community resilience to meteorological hazards is enhanced through agricultural ecosystems. This project focused on capacity building for national researchers and engineers as well as local farmers, which is expected to strengthen the human resources contributing to ecological adaptation in rural areas in the future.

Located in Sub-Saharan Africa, Northern Ghana faces challenging climate conditions. There are concerns that the acceleration of climate change may further reinforce the region's vulnerability. It is predicted that a rise in temperature of 2.3 °C to 4.2 °C caused by climate change will push the region's temperatures even higher during the dry season and exacerbate the impact of droughts (Tachie-Obeng et al. 2014). Climate change is also expected to trigger more floods in the region's Volta River basin (Sawai et al. 2014). In short, climate change is projected to cause rising temperatures and pronounced extreme weather events.

A number of measures can be effective in reducing the impacts of climate change, such as building irrigation dams or installing flood defense infrastructure, but in the poverty-stricken region of northern Ghana, projects requiring large amounts of capital are not feasible options. It is therefore important to promote disaster preparedness and risk mitigation strategies that utilize agricultural ecosystems, and to support capacity building at the community level to enable local people (farmers) to implement these strategies. In fact, coping strategies used by households in communities during droughts and floods rely heavily on ecosystem services, including food provision (Lolig et al. 2014).

The University of Tokyo and the United Nations University, together with several research institutions in both Japan and Ghana, are currently implementing the research project Enhancing Resilience to Climate and Ecosystem Changes in Semi-Arid Africa: An Integrated Approach (CECAR-Africa) in northern Ghana, as part of the Science and Technology Research Partnership for Sustainable Development (SATREPS) program administered by JICA and the Japan Science and Technology Agency (JST).

Figure 14.5 compares the diversity of crops and rice yields from the two districts of Wa West and Tolon (Takeuchi 2015). Wa West enjoys advantages over Tolon in terms of crop diversity. A broader variety of crops implies greater resilience because farmers are better able to adapt to frequent and intense extreme weather conditions by selecting crops with a short vegetation period or greater drought resistance (see Kloos and Renaud, Chap. 9). On the other hand, Tolon's rice yields far exceed those of Wa West. Production volume is essential for farmers to secure sustainable livelihoods. This study concluded that resilience of agricultural

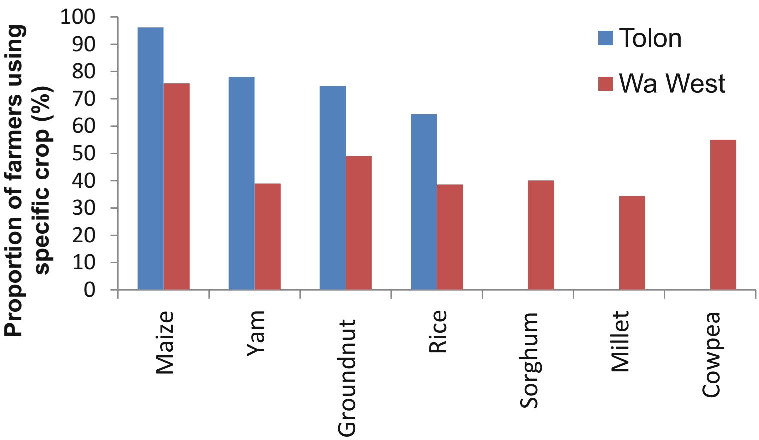

Fig. 14.5 Diversity of crops and rice yields from the two districts of Wa West and Tolon (Source: Takeuchi 2015)

production can be achieved by maintaining crop diversity while at the same time boosting production (Takeuchi 2015)

Shea trees (*Butyrospernum Parkii*) are drought- and flood-tolerant trees common to this region. Some are found in cultivated settings, but the trees grow naturally in the wild in the savannah grasslands. Shea butter, a product extracted from shea tree nuts, is used to produce soaps and cosmetics that are exported worldwide. Research on shea butter production in northern Ghana found that processors in rural areas consume large amounts of water and energy, particularly for the production of high quality butter. With the introduction of a more resource-efficient production process, butter-producing communities could maximize the value of shea trees as a key resource for building community resilience (Jasaw et al. 2015). Given that it is mostly women engaged in shea nut collecting and processing, improved production practices could also lead to skill enhancement and the diversification of women's livelihoods, which in turn would help strengthen community resilience (Otsuki et al. 2014).

As part of the CECAR-Africa project, researchers and engineers from Ghana took part in a skill enhancement training program in Japan and in Ghana. The project also sent a team of Japanese and Ghanaian researchers to target villages, where they held seven community workshop sessions to present their research findings and hold discussions with the villagers and stakeholders (Fig. 14.6). These initiatives provided capacity development opportunities for engineers and local communities alike to promote DRR strategies that utilize agricultural ecosystems and contributed to building a more resilient social system.

Fig. 14.6 Community workshop in Ghana in August 2014 (Photo: Osamu Saito, reproduced with permission)

14.4.3 Building a Resilient Society in Harmony with Nature in Japan after the GEJE

Japan is part of the "Ring of Fire" and its geographical, geomorphological and meteorological conditions make it especially vulnerable to natural hazards (MLIT 2014). As such, Japan's rate of exposure to natural hazards is ranked amongst the highest in the world, along with the Pacific Island States (Alliance Development Works 2014). In particular, the GEJE in 2011 caused the greatest damage Japan has suffered in recent years (see Furuta and Seino, Chap. 13).

This devastating experience has, however, led to the accelerated promotion of DRR measures as well as other initiatives to enhance the resilience of the country. Reports of coastal forests reducing damages during the GEJE also underlined the importance of Eco-DRR. For example, the Basic Act for National Resilience was enacted in 2013, and related measures are being promoted to advance DRR and to expedite reconstruction in a comprehensive and systematic manner based on lessons learned from the GEJE. Harmony with nature and the environment was put forth as one of the basic policies of this undertaking. The Fundamental Plan for National Resilience, which is based on the Basic Act for National Resilience, outlines steps to evaluate the ecosystem functions of natural ecosystems such as coastal forests and marshlands under both extraordinary and ordinary conditions and to actively utilize such functions in DRR measures.

Moreover, authors of this chapter have worked to promote the mainstreaming of the importance of Eco-DRR worldwide through international conferences such as the 1st Asia Parks Congress in 2013 in Sendai, Japan, the Twelfth Meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD COP 12) in 2014 in Pyeongchang, Republic of Korea, the 6th World Parks Congress in Sydney, Australia and the 3rd UN World Conference on Disaster Risk Reduction in 2015 in Sendai (Furuta and Seino, Chap. 13 for details). A notable achievement was the adoption of a decision on DRR and biodiversity at CBD COP 12 based on a proposal by Japan (COP 12 Decision XII/20). The decision encourages Parties to the Convention to promote and implement ecosystem-based approaches to disaster risk reduction.

In this manner, the GEJE became a turning point in Japan and prompted significant progress in domestic and international measures related to Eco-DRR. In addition, reconstruction measures that take advantage of the natural environment of each region have been launched in areas affected by the GEJE with the aim of realizing a sustainable society. Such efforts are being led by Fukushima, Miyagi and Iwate prefectures, the three which suffered the heaviest damages (MOEJ 2013). In the following sections we introduce two initiatives for strengthening the resilience of local communities and contributing to DRR. These initiatives provide best practices of the "socio-ecological sphere" (Fig. 14.3) for adapting to meteorological events. As with the other case studies, these projects utilize multiple ecosystem services with multi-stakeholder participation. Another noteworthy characteristic of both projects is their consideration of the ecosystem and biodiversity in their regions, which is important for ensuring sustainability.

14.5 Restoration of Coastal Forests Along the Area Devastated by GEJE

In Japan, coastal disaster-prevention forests have been developed for centuries for the purpose of preventing or mitigating disasters (see Furuta and Seino, Chap. 13). The tsunami after the GEJE caused flood damage in coastal forests, the total area of which was approximately 3660 ha. An assessment was conducted using aerial photographs and other materials to measure the extent of woodland that was washed away, inundated or destroyed. The result revealed severe damage, with about 30 % of the area rated at a damage level of 75 % or more, and over 20 % rated at a damage level of 25–75 % (Forestry Agency of Japan 2012). Although many coastal disaster-prevention forests were devastated by the tsunami, there were reports of coastal forests helping to dampen the energy of tsunamis and delay their arrival time (Forestry Agency of Japan 2012). It is conceivable that the coastal disaster-prevention forests that were devastated were also effective in this way. Moreover, in coastal disaster-prevention forests where woodland remained, cases were reported in which floating wreckage was trapped and damage to houses and other properties behind the woodland was reduced (Forestry Agency of Japan 2012; Furuta and Seino, Chap. 13). In addition, they can defend against blowing sand and wind and have other disaster prevention functions that play an important role in protecting the region (Forestry Agency of Japan 2012). Based on this, coastal disaster-prevention forests are now being restored in various regions. However, at the same time, there is a fact that many seawalls are still being erected along the coast as a conventional DRR measure (see Furuta and Seino, Chap. 13).

The Greenbelt Project launched in Watari Town in Miyagi Prefecture brings together various stakeholders in the region to work together with the aim of strengthening resilience and reducing the effects of disasters in the region, and restoring coastal forests while giving consideration to the local ecosystem. In Watari Town there are endangered plants and a distinctive forest of black pines along the coastline, covering an area that is 4 km long and 400 m wide. For over 100 years, the scenic forest was a symbol of the town and protected the residents from sea winds and blowing sand (MOEJ 2013). As a result of the GEJE, however, 77 ha of the 120-ha coastal forest were washed away, and the damage also extended to houses (Fig. 14.7). In the eastern district of Yoshida in Watari Town, there were about 230 households before the earthquake, but only 23 families are returning to the area. The restoration and management of the coastal forest and the farmland behind it has become a major issue in this district. Here, we see two characteristics that can contribute to building resilience in the region.

Fig. 14.7 The coastal forest in Watari Town before and after the GEJE (Photo: Tohoku Regional Development Association, reproduced with permission)

One is the adoption of an approach that gives consideration to the ecosystem and biodiversity in the region. Using guidelines compiled by the Forestry Agency of Japan entitled "Future Restoration of Coastal Disaster-Prevention Forests" as a reference, local tree species were selected for cultivation and planting in the region. Also, a broad-leaved forest is being restored behind the pine forest in a 200 m-wide greenbelt. Steps were taken to preserve endangered plant species as well as native broad-leaved trees, while invasive alien species such as desert false indigo (*Amorpha fruitcosa*) and black locust (*Robinia pseudoacacia*) were exterminated (Fig. 14.8). In this manner, efforts are being made to conserve biodiversity while promoting the use of ecosystem services, such as those for DRR.

The other characteristics for resilience-building is the reconstruction plan, which was compiled with the participation of a wide variety of stakeholders, most of which were community-based (Fig. 14.9). The community had a strong desire to realize sustainable development of the region for the next generation. Therefore, in addition to the local government, local residents are also playing an active role in planning reconstruction efforts in the area. Five workshops were held with the participation of a wide variety of stakeholders, including some from outside the town, to compile a master plan for the restoration of coastal disaster-prevention forests (MOEJ 2013). The plan also includes steps to grow seedlings and conduct eco-tours, taking advantage of capacity inside and outside the region and

Fig. 14.8 Eradication of invasive alien tree species in Watari Town (Photo: Takao Ogawara, reproduced with permission)

Fig. 14.9 Map of reconstruction of coastal areas in Watari Town, produced through multi-stakeholder participation (Reproduced from: http://watarigbpj.sakura.ne.jp/dl/masterplan_image with permission)

developing businesses that take advantage of local resources (MOEJ 2013). The approach utilises ecosystem services and gives consideration to the livelihoods of the people in the reconstruction process.

14.5.1 Sanriku Fukko (Reconstruction) National Park

Another project that was launched in a region affected by the GEJE takes advantage of protected areas to build a resilient society in harmony with nature. Based on an analysis of the disaster-stricken areas, Takeuchi et al. (2014) proposed that a combination of ecosystems and social and economic resilience, such as a transformation to sustainable agriculture, provides a variety of options for flexible responses to future disaster risks and improved quality of life. They presented as an example the efforts to create the Sanriku Fukko (Reconstruction) National Park (Fig. 14.10). This is the central focus of the Green Reconstruction Project, whose three basic policies are: (1) make the most of the blessings that nature provides, (2) study the threats from nature, and (3) strengthen interconnections between the forests, farmlands, rivers and coasts. This new national park was established by combining several existing protected areas and upgrading it into one integrated national park. The purpose of this initiative was to support the reconstruction of the

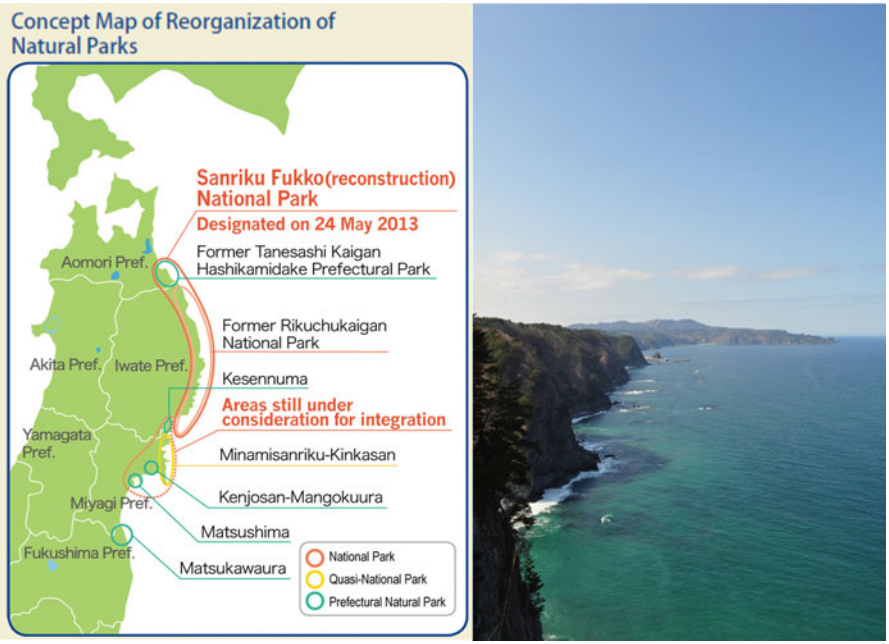

Fig. 14.10 Concept Map of Sanriku Fukko National Park and its landscape (Source: MOEJ, reproduced with permission)

affected areas by creating a 700 km long hiking trail along the coastline, promoting eco-tourism in collaboration with fishermen and disaster education for visitors (MOEJ 2012). It was very symbolic that the name of the national park includes the term "reconstruction" and that it is committed to serve reconstruction activities.

At the Sanriku Fukko (Reconstruction) National Park, efforts are being made to maximize the blessings of nature during ordinary times and protect the people from natural threats when disasters strike. An example of an initiative that attempts to combine disaster prevention measures that strengthen the resilience of local communities with measures to conserve the natural environment can be found on Kesennuma Oshima Island in Kesennuma City, Miyagi Prefecture.

Before the GEJE in 2011, Kesennuma Oshima in the Sanriku Fukko (Reconstruction) National Park attracted many tourists. It was a major center of tourism, providing visitors with a natural environment, nature walks, ocean swimming and fishing. At the time of the GEJE, the island suffered heavy damage from a 12-m tsunami, which took the lives of about 30 people on an island of approximately 3000 residents.

After the disaster, a reconstruction plan was compiled based on discussions between Miyagi Prefectural Government and the local residents of Tanaka-hama beach on Kesennuma Oshima Island. The plan places top priority on the security of the residents and aims to achieve coexistence with the natural environment.

Originally, there was a proposal to construct a sea wall with a height of 11.6 m. However, there was opposition to this from the local community, because it may have damaged coastal landscapes and ecosystem functions. As a result the agreed plan for Tanaka-hama beach includes a sea wall with a height of 3.9 m above Tokyo Pail (Fig. 14.11). The local administrative organ decided to purchase the land inside the embankment, including farmland that was damaged by the disaster, and fill the land so that the maximum height will be 11.8 m above Tokyo Pail. It will create a vegetation base and develop coastal disaster-prevention forests to prepare for tsunamis that occur relatively frequently in the area. It was possible to take such an approach in Tanaka-hama because of geographical features such as the level of the ground, which is higher in inland areas, as well as the fact that several evacuation routes existed, fulfilling requirements for the security of the residents.

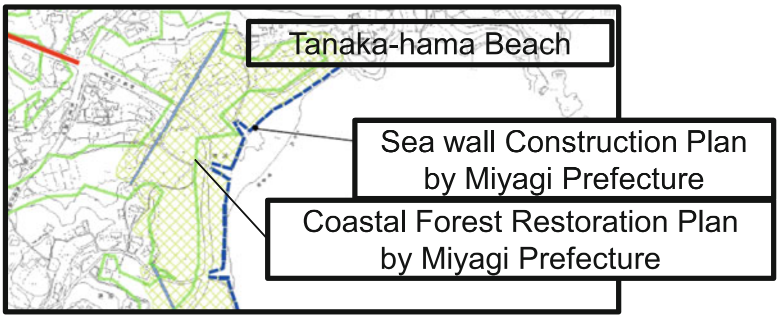

Fig. 14.11 Reconstruction plan in Tanaka-hama Beach (Source: Kesennuma City Reconstruction Plan, http://www.city.kesennuma.lg.jp/www/contents/1387874115071/files/ooshima.pdf)

Fig. 14.12 Evacuation exercise for students on an evacuation route in Tanaka-hama beach (Photo: MOEJ, reproduced with permission)

In addition to these disaster prevention facilities, the disaster prevention functions of coastal forests were used to prepare for future tsunami disaster risks.

The Ministry of the Environment, which is responsible for the management of national parks in Japan, restored facilities near the beach to promote nature experience programs in Tanaka-hama, and prepared for tsunami disaster risks by building an evacuation route that will allow people to quickly evacuate to the top of a hill (Fig. 14.12). During ordinary times the escape route will also be used as a promenade leading to accommodation on top of the hill.

As a result, the scenic coastal landscape was preserved in the process of restoration and reconstruction, and it was possible to continue promoting eco-tourism featuring a nature experience program that takes advantage of various ecosystem services that the national park provides. The plan satisfies the needs of local residents for reconstructing the area as a sustainable community in harmony with the natural environment (Dudley et al. 2015).

14.6 Conclusion

Eco-DRR is a socially, economically and environmentally sustainable tool for DRR that creates new value for a region. It is effective against both geophysical and meteorological hazards, while also providing important benefits in both ordinary and extraordinary situations through ecosystem services. The case studies introduced in this chapter are all efforts to strengthen resilience and promote ecosystem-based DRR with the participation and involvement of various stakeholders, including local communities. In addition to multi-stakeholder participation, it is important to create a virtuous cycle of ecosystem services and the human and financial resources needed to maintain and enhance these services. From these case studies, we conclude that the concept of the “socio-ecological sphere” can be a key element for ensuring Eco-DRR, sustainability and social-ecological resilience.

Such efforts to strengthen the resilience of communities and contribute to DRR are likely to become even more important in the future. In Japan, rapid population decline and aging is expected to cause a shortage of people involved in land management and reduced standards of land management around the country. Meanwhile, as the utilisation of land decreases and more land is abandoned, the costs of maintaining and updating existing social capital are expected to rise (MLIT 2014). If the map of Japan is drawn on grid paper with 1-km squares, it is predicted that in more than 60 % of the currently populated areas, the population will decrease to less than half by 2050 (MLIT 2014). In this situation, it will become increasingly important to actively maintain and restore the functions of ecosystems, especially where measures utilising ecosystems are effective and economical and provide various services to a region. An example of this would be to take an artificial forest of conifers that was abandoned by its managers and regenerate it as a native broad-leaved forest that is more disaster-resistant. Such efforts are also vital from the standpoint of responding and adapting to an increase in natural hazards resulting from climate change. This point of view is reflected in the National Land Grand Design Plan 2050, which proposes that land that has become abandoned as a result of demographic changes and shifts in the distribution of the population should be returned to its natural state (MLIT 2014). Such approaches may serve as a useful reference for other countries where the population is expected to decline in the future.

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