Resilience and Invisible Damage: The 2011 Nuclear Accident and Natural Resources Management

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Abstract

In the Fukushima Daiichi Nuclear Power Station accident, radioactive materials were released into the atmosphere and contaminated natural resources, including a vast area of forests, agricultural lands, rivers, lakes, and the nearby Pacific Ocean. This has had serious impacts on rural areas used for their agriculture, forestry and forest products, and fisheries. Those industries have achieved a certain measure of recovery with governmental aids and TEPCO (Tokyo Electric Power Company Holdings) compensation; on the other hand, the damages on micro-businesses and local subsidiary subsistence activities such as forest recreation, foraging and hunting, or small scale mushroom production have been marginalized from the policies and negotiation for compensation. Despite the fact such micro industries and subsidiary subsistence activities had sustained local livelihoods and bio-cultural assets for resilience, such damages even have been left invisible from society. This paper firstly illustrates the efforts of a forestry park for recreation and environmental education to recover its business, including the negotiation with TEPCO for compensation. The depiction reveals the reality that only the damages that can be calculated in monetary terms and previously expected can only be the subjects of negotiations. The paper explores the detailed invisible damages in the use of local natural resources, which are not in the expected risk and damages lists of TEPCO negotiations and difficult to calculate in monetary terms. Such visualization helps to understand the whole picture of the different types of damage to production and living in rural areas, which was caused by the widespread diffusion of radioactive materials. It also

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clarifies that we need to describe each type of damage while seeing things from the perspective of the people who are living there.

Keywords

Radioactive contamination · Rural life · Diverse use of natural resources · Damages on micro-businesses · Local subsidiary subsistence

9.1 Introduction

The Great East Japan Earthquake that struck on March 11, 2011 was an unprecedented catastrophe leaving more than 20,000 people dead or missing. Furthermore, the Fukushima Daiichi Nuclear Power Station accident immediately following the earthquake worsened conditions in the region because radioactive materials, such as radioactive cesium, were emitted into the ocean and atmosphere over a broad area of eastern Japan.

Fortunately, thanks to the avoidance of serious damage to the reactors' pressure vessels, the impact of radioactive materials was low enough to allow residents to return to live in the affected areas except for those nearest the nuclear power station (1). Although there remain substantial problems (for example, tens of thousands of people are still unable to return to their homes), the designation of mandatory evacuation zones has been since lifted, and the damages because of the impacts of the nuclear accident are being paid. Recovery from the disaster thus seems to be proceeding. However, many challenging problems still remain; for example, there are many people who voluntarily continue to live outside the evacuation zone even after the lifting of the mandatory evacuation order and those who have voluntarily evacuated from areas outside of the mandatory evacuation zones.

During the nuclear accident, large amounts of radioactive materials were released into the atmosphere and contaminated a vast area of forests, agricultural land, rivers, lakes, and ocean. This has had a serious impact on rural areas used for agriculture, forest resources, and fisheries, which rely on such natural resources as regional resources. The ecosystem products and services provided from such industries are consumed in urban areas, and people living in urban areas considered the impact of radioactive fallout as a personal health issue. As a result, the nuclear accident has attracted nationwide attention.

On the one hand, rural residents who were directly affected by radioactive fallout were providers of these products and services; on the other, urban residents were consumers of the products and services. Although both were victims of the accident, a conflict of interest was created, resulting in a long-lasting division between both parties until today.

Rural areas have a strong organic connection with regional resources contaminated with radioactive materials. Not all of the impacts that radioactive materials have had on the production and life of the people living there have been compensated for or recovered from.

This chapter will illustrate how such rural industries were affected by the Fukushima accident, particularly focus on micro-businesses and subsidiary subsistence activities, such as recreational use and mushroom production. Due to its difficulty to be calculated in monetary terms and less evaluation as livelihood practices, such business and activities have been marginalized from the politics and negotiations for compensation and have been left invisible from society. While the efforts with the governmental financial aids and TEPCO compensation led the major regional industries to recovery, such micro-business and subsidiary subsistence activities seem to increase their vulnerability with its invisibility.

9.2 Recovery of an Outdoor Recreation Facility After the Nuclear Accident and its Resilience

9.2.1 The State of Recovery of Agriculture, Forest Resources, and Fisheries as Primary Industries and Their Resilience

Before entering the main subject, we would like to outline the damage to the agriculture, forest resources, and fisheries industries, i.e., the major primary industries that use natural resources, and their recovery from the nuclear accident.

Regarding the impact on fisheries, radioactive materials released into the ocean were diluted by the enormous amount of seawater, which resulted in the reduction of the impact of radioactive materials. Therefore, fisheries have achieved some recovery. For example, test fishing for a limited number of fish species has been conducted in sea areas other than those closest to the Fukushima Daiichi Nuclear Power Station.

In the case of the forestry and timber production, most of the radioactive fallout was found to adhere to the surface of the bark with minimal transfer into the xylem. As a result, timber production was allowed to resume under the condition that the bark was peeled off except in the off-limits areas.

With respect to agriculture, it was confirmed that most of the dispersed radioactive materials was radioactive cesium, and its absorption into the soil and plants was extremely similar to that of potassium, a plant nutrient. To prevent radioactive materials from moving into commercial farm products, the following technological measures were taken: plowing to replace surface soil with subsoil to bury radioactive materials deep in the soil; soil plowing to make radioactive materials adsorb to the voids in the soil; spraying potassium on farmland to prevent radioactive cesium from moving into the plants; and peeling off the bark of fruit trees with radioactive materials on their surface. As a result, the concentration of radioactive materials in foodstuffs was successfully reduced to below reference values, and crop production was eventually resumed in all areas except those that are most severely contaminated with radioactive materials.

Thus, production of natural resources is gradually resuming after the nuclear accident in all affected areas, except in the mandatory evacuation zones. Some compensation is also being paid for the cessation of production and for contaminated

production materials. Although there are still various problems to be solved, reasonable measures have been taken (Hamada et al. 2015).

In regard to major primary industries, clear issues to be solved have enabled technological measures to be taken. Accounting documents in corporate management have also made it easier to economically quantify the damage; some compensation for losses has thus been paid.

However, industries other than the agriculture, forest resources, and fisheries also use natural resources. Their use for recreation and mushroom production are examples of relatively minor but impacted uses of natural resources. Here, we would like to discuss the impact of the nuclear disaster on such uses of natural resources and their recovery from the disaster.

In 2012, after the great earthquake and subsequent nuclear accident of 2011, Kousaka published a book (Kousaka 2012) that focused on the following questions: (1) How did local residents, government, and scientists face the memory of the disaster? (2) How flexibly were regional communities and groups able to systematically cope with and adapt to the accident? and (3) How do they intend to improve their situation? The book addressed the concept of resilience, which is defined as the ability to maintain one's own function and structure by responding systematically to fluctuations and changes imposed from outside and by absorbing shocks. Although resilience was originally a morphological concept, the term has become widely used across many academic disciplines, including research on post-disaster recovery. The notions of how human societies cope with and respond to a shock and what to remember as lessons after the shock are also included in the concept of resilience. Imai and Kanagawa (2011) focused on community governance during the recovery processes after disasters in Yogyakarta (Indonesia), Gujarat (India), and Kobe City (Japan). They clarified that, in these cases, resilience was expressed and shaped through community governance practices created within a framework of mutual cooperation. Abe and Yamamoto (2013) pointed out the significance of cooperation and networking among people for building resilience, and more specifically, that human networks played an important role in developing resilience during the recovery process of a forest owner's association in norther Japan after the earthquake and subsequent nuclear accident.

From this perspective, we would like to discuss how resilience was fostered during the recovery of the minor use of natural resources after the nuclear accident.

9.2.2 The Impact of the Nuclear Disaster on an Outdoor Recreation Facility and Its Subsequent Recovery

9.2.2.1 Overview of the Fukushima Prefectural Forest Park Adatara

The Fukushima Prefectural Forest Park Adatara (hereafter referred to as the Forest Park) is a forest park established in 1972 by Fukushima Prefecture. It was created with the aim of providing the residents of Fukushima Prefecture with a place to learn the importance of nature through interaction with forests and to promote an understanding of harmonious coexistence between humans and nature. The Forest Park is

within the jurisdiction of the Forest Conservation Division of Fukushima Prefecture's Department of Agriculture, Forestry, and Fisheries. It was initially managed by the prefectural government. However, the Forest Ecological Life Foundation (hereafter referred to as the Foundation) has acted as a trustee since FY1998, and it has operated the Forest Park as a designated administrator since FY2006. The services provided by the Foundation were highly valued; for example, the Forest Park received five stars in the comprehensive evaluation of the Japan Auto Camping Federation in FY2001. However, the number of visitors dropped drastically after the nuclear accident in 2011 and the operation of the Forest Park fell into a critical situation. Despite such a serious situation, the great efforts of the operators made it possible to restore the number of visitors to the level of that before the nuclear accident within about three years. The Forest Park is located about 63 km in a straight-line distance from the Fukushima Daiichi Nuclear Power Station, and as such it was not designated as part of an evacuation zone.

The Forest Park consists of a forest learning zone (52.1 ha) and an auto-camping zone (39.4 ha). The forest learning zone was established at the creation of the Forest Park. It has educational facilities, such as a forest learning center and walking trails, which are available for use free of charge. The facilities in this zone are managed by the commission fee from the prefectural government to the Foundation.

The auto-camping zone was created in 1998 when the Foundation was entrusted with the management of the Forest Park. This zone has a visitor center with an exhibition space for nature information, an auditorium, bathing facilities, and a shop; cozy cottages each equipped with a wood-burning stove; and tent sites. Therefore, visitors can enjoy forests and nature while staying there. Because of such highly sophisticated facilities, the Foundation with its expertise was entrusted the management of the Forest Park by the prefectural government.

Visitors to the auto-camping zone pay the fee stipulated by the regulations of Fukushima Prefecture, which goes directly to the Foundation as income. In other words, the quality of operation by the Foundation as a designated administrator determines the number of visitors, and contributes directly to the income of the Foundation. Therefore, its competence in operation is tested. In Japan, corporations that manage public facilities tend to be created as places for former civil servants of the prefecture to gain re-employment, and thus they often lack expertise in management. In contrast, this case goes against such a trend, with most staff members hired as experts in these activities through open recruitment, enabling operation of a highly professional facility.

9.2.2.2 Overview of the Damage to the Forest Park, and Its Subsequent Recovery

On the day of the Great East Japan Earthquake in 2011, the earthquake shook the Forest Park with an upper 5 intensity on the Japan Meteorological Agency seismic intensity scale, resulting in the collapse of some buildings, partial land subsidence, and a reduction in the volume of water in stored water resources.

In terms of impact from the nuclear accident, as of July 28, 2011, the open-air dose rate of radiation in front of the visitor center was 0.48 μSv/h. The open-air dose

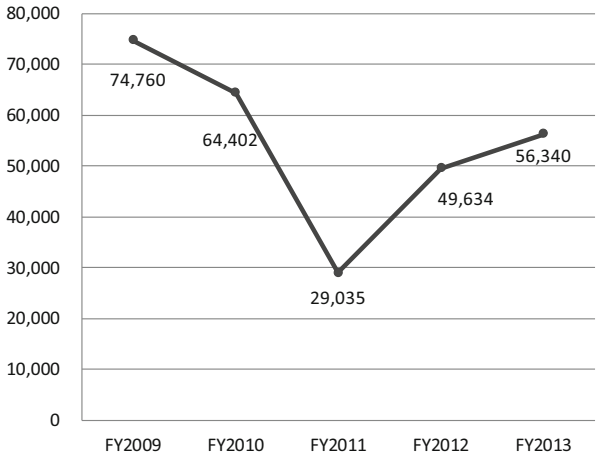

Fig. 9.1 Revenues from Auto Campsites (unit: 1000 Japanese yen)

rates during the same period in several locations in Fukushima Prefecture were: 0.96 μSv/h in Koriyama City in the Kenchu (middle of the prefecture) region (about 58 km away from the Fukushima Daiichi Nuclear Power Station), 0.47 μSv/h in Shirakawa City in the Kennan (southern part of the prefecture) region (about 81 km), 0.15 μSv/h in Aizuwakamatsu City in Aizu region (about 98 km), and 0.19 μSv/h in Iwaki City in the Iwaki region (about 43 km). These data indicate that the Forest Park was heavily contaminated with radiation (2).

Next, let us describe the damage situation regarding the income of the auto-camping zone. The compensation for the Foundation by the Tokyo Electric Power Company, Inc. (TEPCO) was determined based on the sales in FY2009; a comparison between before and after the nuclear accident was thus made based on the values in FY2009. The number of visitors to the auto-camping zone in FY2011 was about 60% fewer than that in FY2009. Cottages in the Forest Park were used as shelters for victims between March and July 2011. Although the Forest Park made an income of 38,832,000 Japanese yen from the use of the cottages as shelters, this income is excluded from the gross income in Fig. 9.1. The sharp drop in the number of visitors and the income in FY2011 may have been attributed to the use of cottages for shelters. However, the income in FY2012 also decreased by about 30% from that in FY2009, suggesting that a large impact of the nuclear accident remained even in this period, during which the effect of the earthquake was fading. At the same time, the whole graph in Fig. 9.1 tells us that the number of visitors is gradually increasing again.

Next, we will describe the damage situation with respect to the number of overnight guests and visitors. Figure 9.2 shows the changes in the number of guests in the auto-camping zone for three categories: adults, children, and infants, where, a child is defined as an elementary school student or a junior high school student, and an infant is defined as a child of preschool age or younger. Although the total number of overnight guests in FY2011 decreased to about 40% of that in FY2009, the number in FY2013 had recovered to about 75%. The number of overnight guests

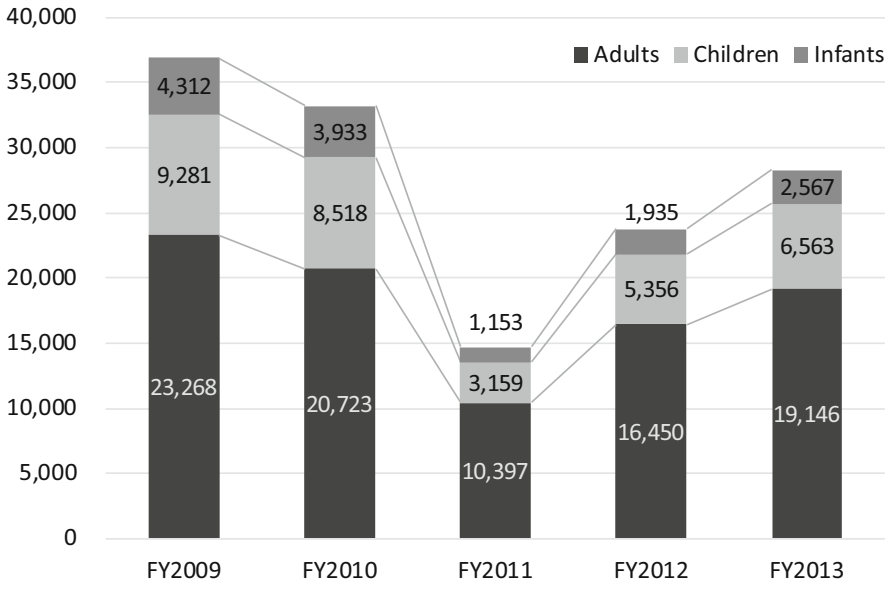

Fig. 9.2 Changes in the number of overnight guests in the auto-camping zone

is slowly increasing in all age groups. Our interview survey revealed that before the earthquake and subsequent nuclear accident, visitors from the Tokyo area outnumbered those from within Fukushima Prefecture. However, after that, the numbers in both groups were similar; this was due to a significant decrease in the number of visitors from outside of Fukushima Prefecture. The Foundation attributes this to the much stronger aversion to radiation contamination held by visitors from outside of Fukushima Prefecture than by those from within Fukushima Prefecture.

Figure 9.3 shows changes in the number of visitors to the forest learning zone. The total number of visitors to the forest learning zone in FY2011 decreased by about 60% as compared with that in FY2009. Although the number of child visitors accounted for more than 60% of that of overall visitors before the earthquake and subsequent nuclear accident, the percentage decreased to less than 40% in FY2011. However, a comparison between FY2011 and FY2013 shows the most significant recovery was in child visitors. Our interview survey revealed that use of the forest learning zone by kindergartens, elementary schools, and junior high schools for outdoor activities increased during the winter because open-air dose rates decreased during the winter snow season due to shielding by snow. The number of visitors in the winter season peaked in January and February, both before and after the nuclear accident. A comparison of the number of visitors in January and February between FY2009 and FY2013 shows that the number of adult visitors decreased by about 10%, but in contrast, the number of child visitors increased by 2% and that of infant visitors increased by 114%.

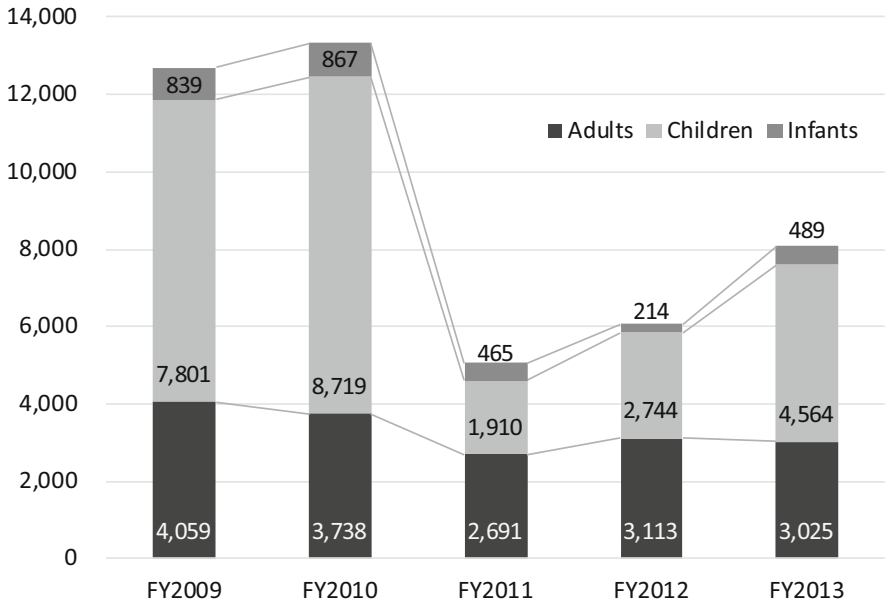

Fig. 9.3 Changes in the number of visitors to the forest learning zone

9.2.3 Responses to and Compensation for the Radiation Contamination

Operators of the Forest Park, under the initiative of the Foundation, have undertaken several responses against the damage from the nuclear disaster described above, in both tangible and intangible ways. At the same time, they have claimed compensation from TEPCO. These are outlined below.

9.2.3.1 Tangible Responses to Radiation Contamination to Restore the Use of the Forest Park

The Foundation began measuring open-air dose rates in the Forest Park and then published the results.

After the nuclear accident, the real world and the Internet space was awash with both positive and negative information on the radiation contamination. In such a chaotic situation, the Foundation measured open-air dose rates in the Forest Park and published the results with the aim of restoring the trust of users by publishing true and accurate values. In July 2011, the Foundation voluntarily purchased measuring devices for 20 measurement sites and measured open-air dose rates once a week to publish the results on their website. In the tent sites, visitors sleep on the ground in sleeping bags and, therefore, the open-air dose rate was measured at 1 cm above the ground. Open-air dose rates at other measurement sites were measured at 50 cm above the ground, which was lower than the standard height, because most visitors were elementary and junior high school students.

Following the measurement of open-air dose rates, the Foundation decontaminated the auto-camping zone. The Foundation considered that the open-air dose rates needed to be reduced as much as possible to provide visitors with a safe auto-camping site. Therefore, on its own initiative, the Foundation temporarily decontaminated a number of tent sites in the auto-camping zone. Specifically, the gravel in the gravel tent sites was replaced with new gravel and the lawn and surface soil in the grassed tent sites was removed and the sites were graveled. Only the decontaminated tent sites were provided to visitors from August 1, 2011 onwards. This was based on the Foundation's philosophy that an operator must not provide a campsite unless safety is ensured.

The Foundation made its efforts independently up to the summer of 2012; however, since that point, decontamination in the Forest Park has been carried out following a plan made by the Forest Conservation Division of Fukushima Prefecture's Department of Agriculture, Forestry, and Fisheries. Frequently used places, including not only tent sites but also the forests around the walking trails, were preferentially decontaminated to meet the use characteristics of the Forest Park. Because of the limited budget, the Foundation and the Fukushima prefectural government talked with each other to prioritize sites to be decontaminated. As a result, decontamination was performed in keeping with the strong intention of the Forest Park that knew every detail of the use trends of visitors.

9.2.3.2 Intangible Responses to Restore the Use of the Auto-Camping Zone

Here we focus on intangible responses made to restore the use of the auto-camping zone.

The Foundation started by significantly reducing the admission fee to the auto-camping zone. Between September 2011 and March 2012, residents of Fukushima Prefecture were given a 50% discount, visitors from outside of Fukushima Prefecture were given a 20% discount, and rehabilitation volunteers were given a 40% discount. This method of discount was subsequently changed and scaled down; only discounts for groups and school educational use are now provided.

The admission fee discount was initiated due to the following two motivations: (1) the Foundation wanted the residents of Fukushima Prefecture, or victims of the disaster, to visit the forests to ease their minds precisely because they were facing the difficulties of the earthquake and subsequent nuclear accident; and (2) although an increasing number of residents outside of Fukushima Prefecture, such as those from the Tokyo area, tended to avoid visiting Fukushima Prefecture after the nuclear accident, the Foundation wanted as many of them as possible to visit the prefecture to revitalize the economy of the whole Fukushima Prefecture.

However, the Foundation was told through consultations with the Fukushima prefectural government that in order to change the admission fee the approval of the prefectural assembly was required because the Forest Park fell within the jurisdiction of the Fukushima prefectural government and the admission fee had been determined by the prefectural regulations. The chaotic situation immediately after the disaster prevented both parties from reaching any conclusion; however, a subsequent

thorough review of documents related to the contracts and regulations revealed that under exceptional circumstances the admission fees were allowed to be changed if given clearance by the Foundation's director. The Foundation thus decided to reduce the admission fee. Under the designated administration system as described above, although this decision was known to reduce the income of the Foundation itself, it was the Foundation's own decision as an involved party that made it possible to reduce the admission fee.

Second, the Foundation enticed visitors from societal segments different from those before the nuclear accident. The Foundation made efforts to attract visitors who had low aversion to radiation and to develop new intangible projects based on the context of the earthquake and subsequent nuclear accident itself.

The former effort was participation in the invitation of motorcyclists as part of a campaign for reconstruction after the earthquake disaster, run by the Fukushima Tourism and Products Association. Sites where local information was available for motorcyclists were posted on the website, Rider's Pit, and the campaign and the Forest Park was registered as a rider's pit. Although families with children were the main segment of visitors to the Forest Park before the earthquake disaster, the number of visitors in this segment subsequently declined because they wanted to avoid exposure to radiation. This strategy was thus implemented in response to the decrease in this segment. In terms of marketing, the majority of motorcyclists in Japan are 50 to 60 years of age, who tend to be rather tolerant of radiation effects. New sales efforts, such as tie-ups with motorcycle magazines, were needed to cultivate new customers.

The latter effort was a disaster education camp project conducted in collaboration with the incorporated non-profit organization Global Network Fukushima and travel agencies.

Global Network Fukushima provides education to help people learn from disasters and disseminates lessons to hand down to the future. The Foundation collaborated with Global Network Fukushima to propose a new disaster education camp to travel agencies, based on the responses to natural disasters and the nuclear disaster that the Foundation had conducted. They eventually succeeded in commercialization.

These efforts have enabled the gradual restoration of the number of visitors to the auto-camping zone.

9.2.3.3 Intangible Responses Made to Restore the Use of the Forest Learning Zone

Before the nuclear accident, visitors to the forest learning zone were primarily children from nurseries, kindergartens, elementary schools, and junior high schools in Fukushima Prefecture. The Forest Guide Association (including volunteer forest guides and nature guides) played a major role in restoring the numbers of these visitors.

Many residents of Fukushima Prefecture have learned from forest guides about the roles and significance of forests while participating together in activities such as nature observation tours, outdoor activities, and forest creation. Forest guides are

qualified volunteer outdoor education instructors confirmed by the Fukushima prefectural government. Forest guides are required to complete a training course accredited by the Fukushima prefectural government. The training course has been offered by the Foundation since FY1999, when the Foundation was entrusted with the operation of the course by the Fukushima prefectural government. Qualified forest guides lead nature observation tours and lessons in the craft of woodworking upon request from elementary and junior high schools and various organizations. Before the earthquake and subsequent nuclear accident, when elementary and junior high school students visited the Forest Park, they usually participated in natural observation tours and woodworking craft instructed by forest guides.

After the earthquake and subsequent nuclear accident, there was little request for nature observation instructors, although the Forest Guide Association was willing to continue their activities. In 2012, however, opportunities to exchange opinions about children's activities in forests gradually increased between forest guides and school officials. Then in 2013, reports on markedly reduced physical strength and obesity trends in children in Fukushima Prefecture influenced the forest guides who remembered children having fun in forests. The forest guides recognized the need for children to resume activities in the forests; therefore, they began to encourage elementary and junior high schools in Fukushima Prefecture to resume the use of the Forest Park. The Forest Park was a safer and more-preferable alternative than other forests because walking trails and surrounding forests in the Forest Park had already been decontaminated.

When visiting schools to promote outdoor education activities in the Forest Park, forest guides explained that the Forest Park had been decontaminated and they presented the data values of open-air dose rates measured in the Forest Park. They also cited the reports on the increasing number of children with reduced physical strength and a trend toward obesity to support the need for outdoor activities. In addition, they explained that the forest environmental tax (1000 Japanese yen per inhabitant of Fukushima Prefecture is collected to be used for matters related to forest conservation) is a local tax levied independently by the Fukushima prefectural government and was thus allowed to be used for necessary expenses for school education using forests. They eventually succeeded in promoting the attraction of children's outdoor activities in the relatively safe Forest Park. As a result, the number of elementary and junior high school children visiting the forest learning zone has been increasing to a level close to that before the nuclear accident. Additionally, our interview survey on usage revealed that requests for activities during the winter season in which radiation was blocked by snow were increasing, particularly among the younger age segment as compared with the number of such requests before the nuclear accident. This is an interesting example of changes in users' usage behavior due to concerns about radiation impact.

9.2.3.4 Damage Claims to TEPCO by the Foundation

We have described above that extensive efforts have been made to recover the usage of the Forest Park. We next analyze the compensation from TEPCO.

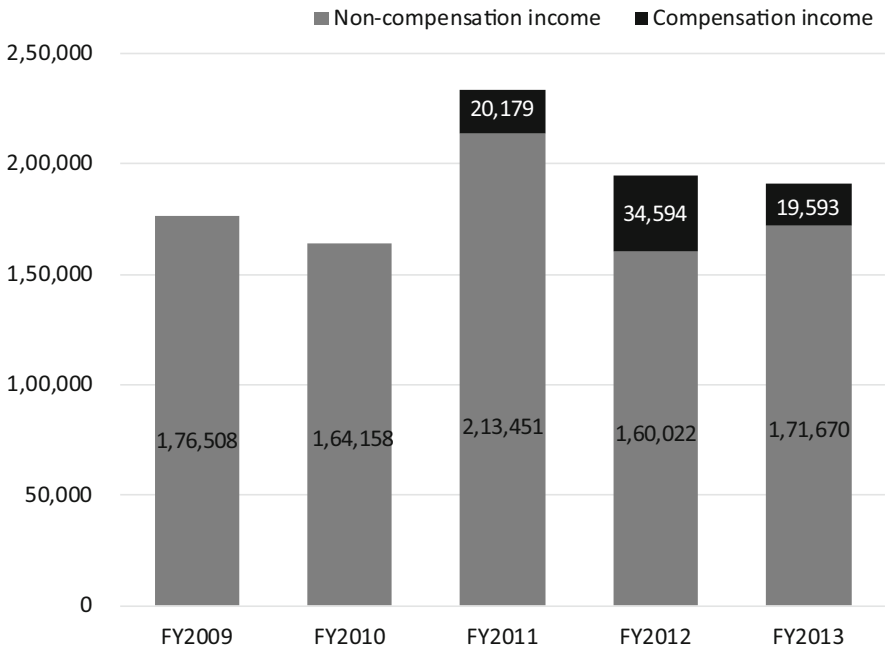

Fig. 9.4 Breakdown between the compensation and non-compensation incomes (unit: 1000 Japanese yen)

In February 2012, the Foundation lodged a claim against TEPCO for the cost of measuring open-air dose rates in the Forest Park; for the lost profits due to the nuclear accident; and for related and additional costs of responding to the nuclear accident. The additional costs included the cost of devices purchased for individual and voluntary measurement of open-air dose rates, the cost of optimizing the website for publishing the measurement results, and the cost of decontamination performed by the Foundation. Figure 9.4 shows the breakdown between the compensation and non-compensation incomes.

Compensation for the costs of open-air dose rate measurements was totally awarded. Compensation for lost profits and additional costs was only partly awarded.

Compensation for lost profits was claimed based on the sales in FY2009. This was because TEPCO considered the income and expenditure of the Foundation in FY2009 as mean income and expenditure before the nuclear accident. Therefore, the lost profit was calculated by subtracting sales in the target fiscal year from those in FY2009 and then multiplying the resulting decrease in value by 0.86, where 0.86 (i.e., 86%) is the contribution margin ratio, a percentage in which costs are deducted from the decreased value. However, not all damages calculated based on this formula were paid. Immediately after the nuclear accident, for example, the amount of damages was determined after a certain percentage of sales was deducted from the

sales decrease because of TEPCO's story that not only the nuclear accident but also the earthquake and following tsunami might have caused sales to decrease. Between March 11 to August 31, 2011, 20% was to be deducted from the sales decrease; however, this decision was reviewed because of many complaints. Regarding the discount rate for lost profits, the perpetrator had considerable discretion; in contrast, victims were placed under the disadvantageous conditions of negotiations.

With respect to the additional costs, the introduction of the devices for measuring open-air dose rates individually performed by the Foundation after the nuclear accident and the expenses related to the publication of the measured values on the website were fully awarded. In contrast, payment for the expenses related to decontamination of the auto-camping zone conducted by the Foundation has been refused for the reason that a policy for compensation has not been determined; in other words, who, TEPCO or the national government, should be responsible for the payment of compensation has not been determined. Unfortunately, there are no organizations or opportunities to determine which of the parties should pay compensation; therefore, expenses incurred by the Foundation's own decontamination of the auto-camping zone is treated as ineligible for compensation.

Furthermore, there is another matter to consider even after receiving compensation. A large amount of compensation is paid all at once, which imposes a heavy tax burden on the beneficiaries. This way of receiving compensation can itself cause tax problems, unlike with normal income.

9.2.4 Resilience Factors in Recovery of the Use of the Forest Park and Need for Social Support

The use of the Forest Park is on the way to recovery in terms of both income and numbers of visitors. This was supported by the efforts of the people involved in the management of the Forest Park and their determination that the relationship between humans and forests should not be broken by the nuclear accident. What made it possible for them to achieve this successful recovery?

First, we can cite the expertise that the Foundation has cultivated and the decision-making facilitated by this expertise. Measurements and publication of open-air dose rates and decontamination of the facilities were implemented based on the knowledge that they had accumulated about the characteristics of the Forest Park and visitors as well as the usage status of the Forest Park. During the period immediately after the nuclear accident, when the details of compensation had not been determined, the Foundation reduced the admission fee, which could have been disadvantageous or even detrimental for the Foundation. It was a significant decision, focusing on the objectives and the mission of the Forest Park. The expertise of the Foundation also played a major role in the acquisition of customers from new sectors of society.

Second, we can cite collaboration with other organizations. After the earthquake and subsequent nuclear accident, the Foundation collaborated with other organizations that shared the same ambition to reconstruct Fukushima, including

the Fukushima Tourism and Products Association, Global Network Fukushima, and travel agencies, in order to work on new strategies for restoring the number of visitors to the auto-camping zone. Collaboration with the Forest Guide Association, with which the Foundation had established a relationship before the disaster, was also enhanced during efforts to restore the use of the forest learning zone.

Such collaboration with other organizations provided reconstruction activities with resources that the Foundation itself did not possess and created results that were not achievable by the Foundation alone.

Determination for the reconstruction of Fukushima supported by the expertise and collaboration was actually the source of resilience.

In the areas most severely affected by the nuclear accident, it is impossible to maintain or recreate the relationships between humans and forests as they were before the nuclear accident. Nevertheless, maintaining the relationship between humans and forests as well as nature in the affected areas is indispensable to ensure a rich and varied life for people living there. The Foundation considers this period as one in which the Foundation is being tested as to whether it will be able to propose a new way of interaction between humans and forests in affected areas. The Foundation is developing new businesses to assure the persistence of the culture of forests in Fukushima Prefecture. How society can support the restructuring of the relationship between humans and forests in affected areas by the victims themselves is a challenging issue that has not yet been resolved.

9.2.5 Existence of Damage that Can Be Calculated in Monetary Terms and Invisible Damage that Cannot Be Calculated in Monetary Terms, and Compensation Problems

The facts of the damage described earlier show that there exist two types of damage: that which can be calculated in monetary terms and that which cannot, namely, invisible damage. Here, the former includes lost profits due to concerns over health damage by radiation, the cost of measuring open-air dose rates, additional costs, and the sales and marketing costs of new customer acquisition.

TEPCO, however, has not paid compensation for all the damages that can be calculated in monetary terms. Even with respect to the compensation claims of the Foundation against TEPCO, compensation for the costs of decontamination was dismissed. The Foundation has made great efforts to restore visitor confidence and numbers by appealing to visitors from segments different from those before the nuclear accident, who are now turning their backs on the Forest Park. However, such efforts, unnecessary under normal conditions, have not been compensated. Furthermore, the system of compensation for lost profits due to the nuclear accident is determined as a compensation based on decrease in sales. Therefore, the greater the increase in numbers of visitors in new segments, who were acquired by the sales and marketing efforts of the Foundation, the greater the decrease in the amount of compensation by TEPCO. The compensation system is therefore extremely advantageous to the perpetrator.

Compensation was determined at the initiative of TEPCO. Specifically, TEPCO unilaterally imposed the discount rate on the victim side at the time of determining the discount rate for sales decrease, probably caused by factors other than the nuclear accident.

TEPCO's compensation for the nuclear accident is not tailored to the victims' position at all. The facility operator sincerely wishes to recreate the relationship of humans with forests and nature, and makes efforts to ensure the safety of visitors and to recover the use of the facility for outdoor recreational activities. TEPCO seems to use the determination and the efforts of the facility operator to decrease the amount of compensation. This attitude of TEPCO toward compensation is actually a serious problem and needs to be changed.

An example of an invisible damage that cannot be calculated in monetary terms is that it is now impossible to spend time in forests in exactly the same way as before the nuclear accident. The Forest Park carried out decontamination by itself, eventually reducing radiation exposure to levels less than in other forests that had also been contaminated by radiation. This has enabled outdoor activities and resulted in an increase in the number of visitors. However, as compared with before the nuclear accident, requests for children's outdoor activities in the forest learning zone are now increasing particularly in winter, in which radiation is blocked by snow. School officials concerned about radiation contamination now have to select the optimal season for activities in the forest, whereas they did not need to do so under previous normal conditions. The Fukushima nuclear accident has thus deprived them of freedom of selection. Forest guides now need to purchase materials, such as acorns, used in woodworking craft from areas with lower open-air dose rates. They did not need to consider such a thing before the nuclear accident. The Forest Park provides people with the richness of interaction between humans and forests—we feel forests in our bodies, enjoy them, and learn from them—which are qualities that cannot be calculated in monetary terms. Former activities happening in the Forest Park are examples of invisible damages. However, being invisible means that these things are not regarded as targets of compensation, and even their existence is not recognized. There is also a lot of invisible damage related to the use of natural resources in other areas similarly affected by the nuclear accident. Because they cannot be visualized, invisible kinds of damages may be treated as something that does not exist in society. Such a situation is a serious problem.

9.3 Invisible Damages in the Use of Regional Natural Resources in Rural Areas Used for Agriculture, Forest Products, and Fisheries

9.3.1 Invisible Damages: Social Division and the Difficulties in Overcoming Them

This section further discusses the invisible damages described in the previous sections.

A comic book, *Hajimari no haru* [Spring as a start], drawn by Yoko Hano (2013), describes high school students in Fukushima Prefecture after the nuclear accident. The main characters are from dairy farming families and families producing shiitake mushrooms (*Lentinula edode*). The story vividly describes their daily lives and suffering as residents and agricultural producers in rural areas affected by the nuclear accident and how they face radiation contamination. The second volume, *Chainsaw Rhapsody*, describes residents of affected areas and agricultural producers severely criticized on social networking service (SNS), as perpetrators by victims and agricultural consumers in areas far from Fukushima Prefecture. The authors remember that such exchanges using SNS were a commonplace occurrence immediately after the nuclear disaster.

Victims who were agricultural consumers living in urban areas labeled as perpetrators victims who were agricultural producers living in rural areas working in agriculture, forest products, and fisheries and who suffered more severely from the disaster, and the former harshly criticized the latter. Such a structure is similar to that seen in some diseases caused by chemicals: for example, drug-induced subacute myelo-optico-neuropathy (SMON) and environmental pollution-induced Minamata disease were initially falsely recognized as epidemic diseases and, as a result, patients with these diseases were brutally criticized and rejected by a large part of society. In any case, once such a structure of social division is created, in which victims cruelly criticize other victims who are more severely affected, those who caused the accident and those who caused damage are exonerated, making the damage worse.

Igarashi (2012, 2018) has written books describing social division in areas affected by the nuclear accident and the efforts of people living there to solve the problem of social division. He wrote in his 2012 book that in the City of Kashiwa in Chiba Prefecture, which was affected relatively more severely by radioactive fallout than other areas in the Tokyo metropolitan area, a forum was established for discussion among consumers, agricultural producers, and merchants in Kashiwa City to set, through mutual communication, the maximum acceptable limit for the damage. Their efforts eventually led to recovery from the disaster while overcoming divisions between and among producers and consumers. He also described the existence of social divisions and how to solve such a problem in his 2018 book, in which he stated that from the very beginning of the nuclear accident, we strongly felt that we did not want the vegetables produced in our hometown to be caught up in meaningless disputes between consumers and producers on the Internet, and that there must be a way to avoid such a problem arising in Kashiwa City, where the distance between producers and consumers is close both physically and psychologically.

After the nuclear accident in Fukushima in 2011, an official of Co-op Fukushima, a regional consumer cooperative (co-op), said, "Although I'm against nuclear power generation, the people who helped us were all those who were in favor of nuclear energy. They taught us the know-how of measuring radioactive materials and brought us measuring devices, which was of great help in distributing local agricultural products and foods. A co-op is generally an organization of consumers.

However, members of regional co-ops usually include producers as well as consumers. Therefore, we cannot prioritize either consumers or producers. We have to deal with such a difficult situation while working together across the region." (3).

On the basis of such an attitude, Co-op Fukushima set a policy to comply with the national standards for radioactive materials in food, in terms of the maximum acceptable level to avoid conflict between producers and consumers. Unlike some distributors, Co-op Fukushima did not set stricter standards in response to consumers' demands. Products that passed government inspections were allowed to be distributed to avoid imposing any further burden on already exhausted producers. Nonetheless, in response to the demands of consumers who were anxious about the government inspections, Co-op Fukushima conducted *Kagezen* investigations: *Kagezen* is a Japanese custom that a meal is prepared and offered for a family member who has been on a long journey away from home or who has passed away. Co-op Fukushima asked 100–200 families from among its members to prepare one extra meal for three meals a day over two days. A total of six meals, plus snacks and drinks, were preserved and then sent to the inspection center. The meals were homogenized in a blender, and the level of radioactive materials in the mixture was measured. The results showed that levels in foods produced in Fukushima Prefecture were extremely low and extremely unlikely to cause internal radiation exposure. These strategies ameliorated both the exhaustion of agricultural producers within the region (who were exhausted from responding to problems of radioactivity) and the anxiety of consumers to be reduced. Co-op Fukushima tried to protect both producers and consumers—in other words, all citizens living together in the same area.

Co-op Fukushima succeeded in overcoming social division by these strategies because it is an organization that includes both producers and consumers and, in addition, as Igarashi mentioned, because the distance between producers and consumers was close both physically and psychologically. The example of Co-op Fukushima is almost an exception, and only a few cases have succeeded in overcoming social division.

This division between affected rural areas and urban areas as distant consuming areas still persists, as clearly shown in the problem of reputational damage, in which claims of both parties do not mesh with each other, with regard to the safety of food. The nuclear accident has thus left a tremendous problem of social division.

Under such a situation, the statement, "Those who were helpful were people in favor of nuclear power generation" has significant meaning. On social media, we can still find messages expressing the sentiment that the anti-nuclear protest movement did little more than agitate excessively about the risks of radioactive materials, and was not at all helpful for the reconstruction of affected areas and even behaved as an enemy of agricultural producers in affected areas. Immediately after the nuclear accident, people against nuclear energy falsely treated victims in affected rural areas as perpetrators. This may be partly the reason why the anti-nuclear power movement in Japan has not gained significant momentum, even after such a serious nuclear disaster.

Now that a nuclear disaster has occurred, we have to review many things to overcome social division: How should we have accepted the disaster and set the maximum acceptable limit? How should we have built a social framework to support people's diverse ways of living; for example, victims with high interest in the safety of food, those who want to evacuate from the affected area, and those who want to continue to live in the affected area? How should we have communicated with people with different opinions and perceptions about the risks of nuclear power generation?

9.3.2 Invisible Damages: Severance of Organic Connection with Local Natural Resources and Loss of Pride as Producers

To find out the impact of the nuclear accident on the lives and production of people in rural areas who use local natural resources, we present a case example of the impact on one organic farmer in a slightly contaminated area.

The example introduced here is that of an organic farmer (Farmer A) who lives in city X in southern Iwate Prefecture. His main source of income as a farmer was chicken farming. In addition, he did small-scale dry-field farming, rice cultivation, sheep fattening, and beekeeping for subsistence farming. He owns a total of 6 ha of land, of which 2 ha are farmland and pasture and the remaining 4 ha are woodland.

Farmer A carried out organic farming, focusing particularly on the use, circulation, and ecological cycling of local natural resources. Specifically, he used self-mixed feed with local ingredients for chicken farming, and chicken manure was applied to the fields. Most cash earnings came from the sales of chicken eggs; he delivered eggs to households in the local area twice a week and shipped eggs directly to restaurants in Morioka, the capital of Iwate Prefecture. Such a direct delivery system enabled him to develop a close relationship with local customers, which resulted in successful management. In addition, he enjoyed sheep grazing, producing vegetables for self-sufficiency, and using non-industrial and secondary natural resources and regional resources.

After the nuclear accident, he replaced part of the locally obtained chicken feed with feed obtained from western Japan. As a result, radioactive materials were not detected in his chicken eggs. Thanks partly to the direct trust relationship with consumers, his sales did not decline. In contrast, he lost his way of farming based on his beliefs as an organic farmer, i.e., the ecological cycling of local and regional natural resources. This was a matter at the heart of his own identity as a farmer and regionally connected producer. Before the nuclear accident, he used to sell several of his grass-fed sheep each year wholesale for meat to restaurants in Miyagi Prefecture, but after the accident, he had to give it up. He could have removed the surface soil of his pastures for decontamination; however, the area of pasture was too large for him to decontaminate by himself. In addition, although he could have explained the safety measures he had taken to the restaurants, he wondered whether the restaurants would be able to explain the situation to their customers. These are the reasons that he eventually abandoned selling his sheep.

His non-industrial and secondary uses of regional natural resources were also seriously affected by the nuclear accident. He thoroughly plowed the ground to replace the surface soil with subsoil to bury radioactive materials deep into the soil, to a level that was too deep for vegetable roots to reach. As a result, radioactive materials were not detected in his vegetables, enabling him to continue the production of vegetables for private use. In contrast, beekeeping for both private and commercial uses had to be given up because no one knew from where the bees collected honey, which made him too anxious to continue beekeeping for either commercial or private use. Shiitake mushrooms that he grew on logs from his own *satoyama*, or human-modified forest, continued to be tested for radioactive materials, but unfortunately, radioactive materials were still detected even four years after the nuclear accident. This fact mentally devastated him so severely that he had to stop the production of shiitake. Furthermore, relatively high levels of radioactive materials were detected in the ash of firewood that he collected from the mountain behind his house in 2012. He therefore stopped using the contaminated firewood, and now needs to purchase safe uncontaminated firewood.

The example here may be a matter of his mental damage rather than that of radioactive materials themselves. Nevertheless, Farmer A did farming, focusing on the ecological circulation and cycling of regional resources, with the aim of providing safe and secure food for both customers and himself. The entry of radioactive materials into the circulation of regional resources forced him into a situation where he had to produce products that compromised his core values and thus his pride. This has transformed his joy of production into agony. Moreover, he also lost the non-industrial and secondary uses of natural resources that have been symbols of living in a rural area and his rich *satoyama* relations with the nature surrounding him. Such a situation may be common among organic farmers who have made efforts to provide safe and secure foods. Radioactive materials have undoubtedly had an impact on rural living and on the fruitful interactions with nature for all people living in rural areas.

However, as described above, the non-industrial and secondary uses of natural resources, such as beekeeping and the use of firewood as well as the small-scale production of meat from grass-fed sheep, was given up only voluntarily even though Farmer A farms in a lightly contaminated area. Therefore, they cannot be included in the scope of compensation by the perpetrator. If the sales of farmer A's eggs had decreased, the decrease in sales might have been visualized and quantified to be included in the scope of compensation. The feeling of grief and painful resignation that the organic farmer has felt because he had no choice but to replace the local-made feed with that produced in western Japan was completely ignored. In other words, under the present conditions, impacts other than those having a numerically clear impact on the agricultural management for profit are ignored.

9.3.3 Invisible Damages: Severance of Organic Connections with Local Natural Resources and Damage to Social Capital

Although timber production is always focused on with respect to the impact of the nuclear accident on forestry and forest resources, here we describe shiitake production on logs as an example of another important local subsistence and commercial use of forest resources.

The Fukushima Nuclear Power Plant accident caused widespread radiation contamination, most importantly with radioactive cesium. Because mushrooms tend to easily absorb radioactive cesium, the nuclear accident had serious impacts on the cultivation of shiitake mushrooms in the region. Shiitake mushrooms are grown largely in two ways: production on substrates and production on logs. In the former method, the substrates are media made of a mixture of sawdust and nutrients; they are inoculated with spores and placed indoors. In the latter method, the logs are generally about 10 cm in diameter and 1 m long; they are inoculated with spawn and mainly placed outdoors. Each log is generally used for about four years.

Our research focused primarily on shiitake production on logs. This type of production is conducted in a variety of operational systems, ranging from industrial large-scale cultivation that uses several tens of thousands of logs a year to small-scale production using a few tens of logs as a form of minor subsistence that is a subordinate source of income for farmers. The industry is also associated with a relationship between humans and nature in a local setting: mushroom farmers make sustainable use of the roundwood obtained from local broad-leaved forests. We surmised that the widening gap between the actual damage to shiitake production and damage compensation would have a consequential impact on the recovery of production and on producers' permanent residency in rural areas. However, as of this writing, the damage related to shiitake production has not yet been fully studied.

The survey area, Daito-cho, Ichinoseki City, Iwate Prefecture, was one of the leading places of production of shiitake on logs (dried shiitake) in the prefecture and produced over 100 tons of the products during peak periods. The southern part of Iwate Prefecture was relatively heavily contaminated by radioactive fallout; the independent investigation by the Ichinoseki City government in July 2011 immediately after the nuclear accident recorded the highest open-air dose rate of 0.47 μSv/h at 1 m above the ground, although the dose rate was significantly lower than the reference level for evacuation. Radioactive cesium exceeding the maximum legal level was detected in the raw shiitake mushroom on logs (open field cultivation) in April 2012, and as a result, shipment of the products was restricted by the national government. Subsequently, in April 2015, only products that were cultivated and managed in compliance with the cultivation procedure to ensure safety prescribed by the prefectural government were allowed to be shipped again.

The shiitake producer register of Iwate Prefecture in 2012, a list of names of those who produced and sold shiitake for commercial purposes, listed 138 shiitake producers in Daito-cho before the nuclear accident. The investigation by Ichinoseki City government between the time of the accident and 2016 showed that only 29 of them intended to resume production of shiitake by purchasing uncontaminated logs

from other areas. Four producers resumed production immediately after the shipment restriction was lifted in 2015. An additional 11 producers (a total of 15) were allowed to resume shipment in the autumn of that year. As of February 2017, 16 producers, including one additional producer, were allowed to resume shipment. However, the subsequent restarting of production has been very slow; far more than 80% of producers still face restrictions on shipment.

We interviewed six shiitake producers (three had resumed production and the other three had given it up) and part of the results are presented below (4).

Those who were able to resume production were limited to large-scale producers with employees and with over 10,000 logs inoculated annually as of the day before the nuclear accident. To resume production, they were obliged to purchase logs from other areas without contamination. To avoid the impact of radioactive materials, these producers had to change their method of shiitake cultivation from the previous open-field cultivation: from growing shiitake in the woods to growing them inside buildings. In other words, participation in and connection with local *satoyama* forest resources and an organic cultivation relationship were forcibly severed. The necessary aspects of producing shiitake unique to "this" place decreased; producers were required to shift their way of shiitake production to one that was available anywhere.

The cost of purchasing logs was covered by compensation. However, damages were paid only after the logs had been purchased and it was therefore difficult for small-scale management bodies without a financial allowance to do business under the given condition. There was a large gap between small- and large-scale producers with regard to the compensation for the shipment restrictions after the nuclear accident. All producers were required to submit records of the number of logs and those inoculated. However, it was hard for small-scale producers who obtained logs on their own to prepare certification documents such as purchase records. Accordingly, this prevented them from receiving appropriate compensation. In contrast, large-scale producers were able to prepare such documents and ledgers because of their to-scale administrative infrastructure and management, which resulted in receiving sufficient compensation (Yamamoto and Shitara, 2017). In terms of compensation, the relationship with regional resources that was not able to be quantified or documented, unlike purchase and sales records, was treated as something that did not exist.

It is clear that it is difficult for small-scale farmers, who cultivated shiitake for sales as an essential part of their non-industrial and secondary uses of local and regional natural *satoyama* resources before the nuclear accident, to resume cultivation. Even though they can resume management, they are forced to change their management style to a more modern one that has only a tenuous relationship with regional resources.

For example, Shiitake-Producer B was a relatively large-scale producer among those who had given up resuming production. He thought that he actively contributed to the local community through the purchase of local logs and hiring of local residents during busy seasons. However, in contrast to his perceptions, some neighbors said to him, with regard to compensation claims, "How much longer are you going to do such a thing?" and "Are you doing it for the money?" His

relationship with local residents eventually got worse. Furthermore, his children no longer return home with his grandchildren even to help him during the busy season because of the fear of the impact that radiation would have on their children; he has lost opportunities for family get-togethers. At a gathering of shiitake producers in Iwate Prefecture, there was a dispute between shiitake producers in the southern (heavily contaminated) and northern (less contaminated) parts of the prefecture, saying "Because of the furor you created, our shiitake produced in northern Iwate is also criticized as being dangerous." (5) His interview revealed that social capital had been broken within the local community, within the extensive peer network of shiitake producers, and within and across families. In addition, it was shown why victims engage in defensive concealment of damage (Funabashi 1999), whereby they do not talk about their damage to avoid discriminatory treatment.

9.3.4 Invisible Damages: Compulsion for Industrialization and Modernization of Production, and Living in Affected Rural Areas and Defensive Concealment of Damage

In the previous sections, we described kinds and degrees of invisible damage in rural resources-producing areas. We have documented kinds of severance of the relationships between humans and nature, such as the severance between rural areas used for agriculture, forestry and forest resources, and fisheries and their relations with urban areas. We have documented the severance between primary subsistence and commodity producers and their consumers and the difficulty in overcoming these severed ties. We have documented the loss of vital organic connections with local and regional resources in primary-producer industries and rural lifeways using regional resources. And, we have documented damage to the core values and sense of pride in rural producers, and the damage to social capital within families, local communities, and peer networks. One final overlooked damage occurs as rural producers, seeking to restore their production livelihoods and practices, often show a compulsion for modernization of production and life in rural areas and in the production of products.

To resume agriculture in contaminated areas, modern agricultural techniques, such as deep plowing, plowing to replace surface soil with subsoil, and potassium fertilization, are indispensable. With respect to compensation, clear and quantitative damage in modern industrial agricultural management for profit is generally compensated. In contrast, rural life with non-industrial and secondary uses of natural resources, such as beekeeping and firewood utilization as well as small-scale agriculture, such as the production of grass-fed sheep meat, which represents the culturally rich *satoyama* relationship with nature in rural life, are not compensated because the farmers "voluntarily" gave up these activities.

In terms of shiitake production, only producers of large-scale organizational management were able to resume production; however, small-scale producers who failed to adapt had to close their operations.

The Toyoma-machi Forest Owner's Cooperative Association in the northern part of Miyagi Prefecture, was affected by radioactive materials to the same degree as Daito-cho. The Association supported small-scale shiitake producers who obtained logs on their own and did not have purchase records, with respect to the compensation claim against TEPCO. Specifically, the Association presented the number of shiitake spore plugs sold by the Association, and then the number of bed logs was determined based on the average number of spore plugs required for each log. After compensation was settled, a member of the Association said that producers who would not be able to switch to a more corporate management style might have to quit their jobs as shiitake producers. (6).

The nuclear accident was a failure of modern science and technology. To claim compensation for the damage to the living and production in rural areas to aid in recovery from the damage, the affected people have been forced to further modernize their agricultural management methods and farming technologies. Their freedom to enjoy agriculture, which is not always industrial or solely concerned with maximizing production, as well as their rural life, while enjoying their traditional satoyama relationship with rich nature, has been taken away. This may be a type of damage that not only urban residents but also, as Fujikawa (2012) pointed out, victims in rural areas used for agriculture, forestry and forest resources, and fisheries, are not aware of.

Finally, defensive concealment of damage by victims amplifies visible and invisible kinds and degrees of damage to agricultural production and rural life of all the residents in rural areas. Victims are likely to refrain from claiming their damage out of consideration for other residents and people in the same trade. This is because the victims consider that their claims may lead to their local area and products being recognized as being contaminated. Unfortunately, however, this consideration exacerbates the invisibility and latency of these damages. Such damages to the people living in rural areas tend to be invisible as a result of their own actions.

9.4 Conclusion

Investigations in rural areas and the use of natural resources after the Fukushima Daiichi Nuclear Power Station accident revealed that the nuclear accident not only caused health damage but also severed the relationships between humans and nature as well as between and within families and communities.

Efforts to recover from the nuclear accident are being made in affected areas. The expertise of people involved in rehabilitation and efforts based on the cooperation of a range of governmental and non-governmental organizations are promoting resilience in the recovery from the nuclear disaster. Yet, the recovery is only half done; social support for the efforts of victims, including the improvement of the compensation system, needs to be enhanced and continued.

These investigations also revealed the existence of invisible damages, which make ongoing recovery more difficult and, at the same time, it is all too often not recognized as a problem in the first place.

As described in the previous sections, invisible damages in rural areas cannot only be seen, but also appear differently according to the way of living in each region based on the diversity in nature and on the degree of damage. To understand the whole picture of the different types of damage to production and living in rural areas, which was caused by the widespread diffusion of radioactive materials, we need to describe each type of damage while seeing things from the perspective of the people who are living there. Unfortunately, however, there have been only a few reports written from the perspective of the people to describe the kinds and degrees of damage to the people who continue to live in rural areas using natural resources that have been affected by the nuclear disaster.

It is difficult for urban residents, who make up the majority of the Japanese population, to understand the kinds and degrees of invisible damage that have impacted the people who continue to live in rural areas using natural resources that have been affected by the nuclear disaster. This issue has been left unresolved due to the following reasons: the damage is not as obvious as damage due to evacuation; the damage is difficult to calculate in monetary terms; technical solutions seem to be unsuitable; the damage manifests different aspects in each region and each sector of resources use; victim-oriented defensive concealment of damage is likely to occur, which exacerbates the invisibility of the damage; and there are only a few cases described.

There may be discussion about the pros and cons of living in areas contaminated by radioactive materials, even areas of low doses. The authors thus think that the right to evacuate should be supported. On the other hand, there are many victims who chose to stay in rural areas used for agriculture, forestry and forest resources, and fisheries that were affected by the nuclear accident, while daringly accepting the risk of low-dose radiation. Choosing to stay there does not mean that there is no damage. Despite the fact that there are numerous types and degrees of damage, the damage there is treated socially as if it did not exist. This is actually a serious problem and may leave victims in a difficult situation. In addition, underestimating the damage may lead to the acquittal of the perpetrator.

We need to further advance investigations tailored to affected areas before the Fukushima Nuclear Power Station accident is considered simply just another past event. Specifically, descriptions about invisible damages, which are difficult to calculate in monetary terms, should be carefully collected. Then, we need to characterize the problems, inductively using the enhanced data collected, help society to recognize the existence of these kinds and degrees of damage, and make the perpetrator and government pay damages and support for recovery, including preventing nuclear accidents from recurring.

Notes

1. Although there is still discussion about initial iodine exposure due to dispersed radioactive materials and the subsequent impact of low-dose exposure on health, we omit discussion of that point in this article.
2. Fukushima Prefecture "Results of Radiation Monitoring" (accessed on October 29, 2014) http://www.pref.fukushima.lg.jp/sec_file/monitoring/m-0/sokuteichi2011.7.28.pdf.
3. From an interview with official of Co-op Fukushima, November 12, 2013.
4. Full details will be reported separately.
5. From an interview with shiitake producer B in Daito-cho, Ichinoseki City, Iwate Prefecture, December 13, 2016.
6. From an interview with an official of the Toyoma-machi Forest Owner's Corporative Association in Miyagi Prefecture, October 18, 2016.

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