

Radioactive Contamination of Fukushima's Forests: Application of the Polluter Pays Principle

Linas Didvalis *

I. Introduction

Similar to the rest of Japan, two-thirds of Fukushima Prefecture is covered with dense forests. As they are distributed quite evenly throughout the prefecture, a wide area of forested land was contaminated by radioactive fallout during the accident at the Fukushima Daiichi nuclear power plant. Workers in the forestry industry and local residents have been advised to stay away from forests until a solution is found to make them safe for human health. In other words, forests that used to provide people with wood, mushrooms, wild vegetables, water for rice paddies, and spiritual comfort suddenly became threatening places. Naturally, many of the local people want the forests to be returned to the state they were in before the accident as soon as possible. That is especially true of people working in Fukushima's forestry industry, because their welfare directly depends on how quickly the forests become safe and trusted again.

As explained in greater detail later in the article, there are two main approaches to the problem of radioactive contamination of forests. The first is to wait for the radioactivity to diminish naturally, as has happened in the forests surrounding Chernobyl (Little & Bird, 2013). This will take several years for the least contaminated forests and decades for those contaminated by the most severe radioactive fallout. However, the only actions required in this scenario are to accept the consequences of the accident, learn to live close to “no-go”

* PhD Student at International Christian University

zones, and be patient.

The second approach is to find the most effective ways to remove radioactive materials from forests and start unprecedentedly large-scale decontamination works. This would be a much quicker way to reduce radiation to acceptable levels, as some experiments conducted in Fukushima have shown (JAEA, 2012, pp. 166–8). However, among other existing challenges, decontamination requires substantial financial and human resources that would have to be provided by the company that caused the pollution, the state, or property owners themselves.

Neither waiting nor active decontamination is an ideal solution for all interested parties. The forestry industry is certainly not happy to wait for some years for the levels of radiation to decrease naturally and would prefer a quicker solution. Local residents do not want to be afraid of radiation spreading from the forests into their living environments. On the other side stands the Tokyo Electric Power Company (TEPCO), the owner of the nuclear power plant, which is not keen to take responsibility for the radioactive contamination (Maeda, 2011). The Japanese government has created policies to cope with the consequences of the accident, but it has much more pressing issues to deal with than organizing decontamination of vast forest areas. As a result, the question of “what to do with the forests” is left unanswered, at the expense of the people for whom this limbo causes daily financial and psychological damage.

One way to address this problem is to turn to environmental law and apply one of the most widely accepted concepts in the field, namely the Polluter Pays Principle (PPP). The PPP can help us answer many difficult questions such as “who is responsible and for what?,” “who has to pay for the damage?,” and so on. However, because of the rare nature of nuclear accidents, there are many issues that the PPP has not been used to address; therefore, analysis of such cases is urgently needed.

The goal of this article is to analyze how the PPP has been used in Japan after the nuclear accident, what its limitations are, and whether it can be an effective tool to provide just compensation for victims of radioactive

contamination. The article is organized as follows. Section II presents the current state of Fukushima's forests, their radioactive contamination, and responses to the problem. Section III provides more details about the PPP and its importance in the context of the Fukushima Daiichi nuclear power plant disaster. Section IV discusses how the PPP has been applied in Japan after the nuclear accident. I argue that there are three major limitations in the current damage compensation policy with respect to the forestry sector: 1) there is no option for the forest owners to request forest decontamination; 2) there is no compensation for standing forests, only for forest products that are not fit for consumption due to their high radiation levels; and 3) there is no system to compensate for broader damage done to forests and their users. The final section of the article presents concluding remarks.

II. Fukushima's Forests and Issues Associated with Their Radioactive Contamination

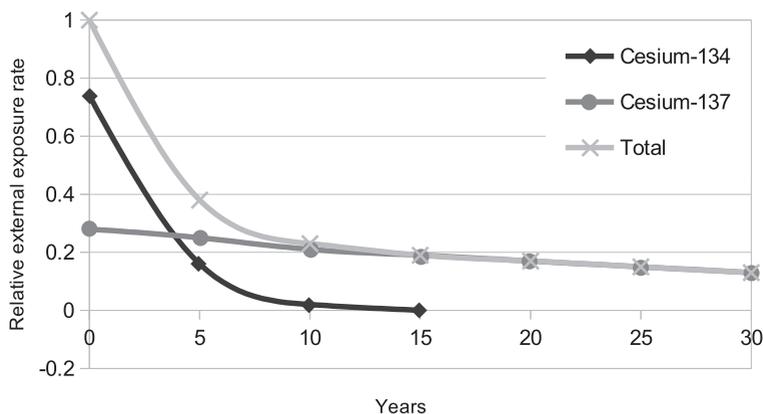
Forests in Fukushima Prefecture cover 972,000 ha or 72% of the total land area (Fukushima Prefecture, 2010). Private forests account for 57.8% of the forests and the rest (42.2%) are national forests. More than one-third of all forests (35%) are plantations that need regular human care in order to provide high-quality forest products and ecological services. Forest owners make up almost 3% of all residents in Fukushima, more than 57,000 in all.

In 2010, Fukushima Prefecture's annual timber production was 763,000 m³ or about 4% of all timber produced in Japan (Fukushima Prefecture, 2010), with three-quarters of that amount (76%) coming from private forests. Because of the accident, in 2011 (the most recent year for which data exist), production fell to 691,000 m³ or by 9.5% (Fukushima Prefecture, 2013).

Radioactive contamination in Fukushima mainly comes from two cesium isotopes —cesium-134 and cesium-137— that were originally deposited in equal amounts (Munro, 2012). Cesium-134 has a half-life of 2.06 years (every 2.06 years its radioactive potential naturally decreases by half), whereas the half-life of cesium-137 is much longer—30.17 years. Because of the natural

decay of cesium-134, the radiation level in Fukushima is falling relatively quickly. By 2015-2016, cesium-137 will become the dominant source of radioactive contamination and natural decay will slow down substantially (see Figure 1).

Figure 1. Reduction of the relative external exposure rate of cesium-134 and cesium-137 because of radioactive decay (original ratio 1:1).



Source: International Atomic Energy Agency (2011)

At the end of 2011, the radiation exposure of almost 230,000 ha of forested land (around 24% of all forests in Fukushima) exceeded 1 mSv/year (Kawasaki, 2012), which is an acceptable artificial dose for members of the public set by the International Commission on Radiological Protection (Valentin, 2007, p. 36). Because of the natural decay of radioactive materials and their dispersal by wind and rain, some less contaminated forests have already crossed the 1 mSv/year threshold by now, and it is expected that more forests will do the same in a few years (Hiroshi, 2013). However, despite this natural decontamination process, it will take decades for some forest areas to become safe for humans. One way to hasten these changes is to decontaminate the land by removing dead leaves and the top layer of soil, cutting branches, or entirely clear-cutting most

contaminated forests.

Both naturally occurring radioactive decay and artificial decontamination have numerous advantages and disadvantages that must be considered (see Table 1).

Table 1. Advantages and disadvantages of natural and artificial forest decontamination.

	Natural decontamination	Artificial decontamination
Advantages	<ul style="list-style-type: none"> •Low operational cost 	<ul style="list-style-type: none"> •Comparatively quick solution •Prevents migration of radioactive materials •Contaminated biomass can be used for energy production •Jobs for local people
Disadvantages	<ul style="list-style-type: none"> •Takes a long time •Risk of migration of radioactive materials •Risk of forest fires because of poor maintenance •Losses for the forestry industry •Risk of people visiting forests •Negative psychological effect for local people 	<ul style="list-style-type: none"> •Logistically challenging •May require repeated procedures •Radiation risk for workers •Need for long-term storage facilities for contaminated soil, litter, etc. •Damage to the forest ecosystem •Requires many financial resources

Sources: Little & Bird (2013), Hashimoto, Linkov, Shaw & Kaneko (2012), and Hashimoto, Ugawa, Nanko & Shichi (2012)

The main difference between natural and artificial decontamination is the amount of time and resources required. Waiting for radioactivity to diminish by itself costs very little relative to the financial and human resources needed to decontaminate vast areas of forest. Official estimates indicate that the budget for the current decontamination plan will reach a staggering 11 billion USD, and that does not include decontamination of forests (Ministry of the Environment, 2013a). On the other hand, artificial decontamination can turn forests into a safe environment for humans in a few months or years; natural decay will take

decades to have the same effect. This long waiting period means that forest owners will suffer losses, as they cannot log trees and sell timber or other forest products from their property. In the case of Fukushima, the forest owners were advised after the accident to stop their activities and wait for further developments, which has been a major disruption for the local forestry industry (Kirino, 2011). For these people, making forests safe as quickly as possible (i.e., decontaminating them) is the preferred option.

From the standpoint of human safety, decontamination is also a better option because it can reduce the risk that radioactive cesium will migrate from forests to agricultural fields or living areas. This happens when radioactive materials are washed out of the forest with rain or by river water. Forest fires that have the potential to widely disperse radioactivity concentrated in biomass are also a threat, especially when forests are not maintained properly. Decontamination can reduce these risks because contaminated soil, dead leaves, wood, and other materials can be stored in special facilities in a controlled environment.

Of course, it is possible to combine these approaches (artificial decontamination and waiting for radioactivity to decay naturally) by estimating which of these two is needed more and it would be more cost-effective in a given area. In fact, the Japanese government has chosen to respond to the contamination in exactly this way.

Because Fukushima Prefecture is a relatively densely populated area, evacuating residents to escape the negative effects of radiation is not a viable option. Instead, large-scale decontamination is being used to turn polluted areas back into safe living environments. To systematically organize decontamination works, on August 30, 2011, the Japanese Diet adopted the Act of Special Measures Concerning the Handling of Radioactive Pollution (the Act), which went into effect on January 1, 2012. Based on this law, the Ministry of the Environment (MoE) developed Basic Principles to regulate decontamination. According to these principles, contaminated areas are ranked by their importance “from the viewpoint of the protection of human health,” which means that places with a greater risk of negatively impacting humans are to be decontaminated

before those with a lower risk (MoE, 2011). At the top of the list are schools, public spaces, houses, and roads. In other words, areas where people (especially children) spend most of their time. Next on the list are agricultural fields and forested lands that are within 20 m of residential areas. At the bottom of the list are uninhabited places such as grasslands and deeper forest areas, as they pose little threat to human health.

The responsibility for decontamination is divided between the central and local governments. The most contaminated areas close to the Daiichi nuclear power plant are administered by the MoE and the remaining areas must be handled by local municipalities. In both cases, decontamination plans have to be prepared according to the Act (Kawasaki, 2012). Although the cost of all activities is now covered by the national government, according to the Act on Compensation for Nuclear Damage, the company responsible for the nuclear power plant (TEPCO) must eventually take full financial responsibility (MoE, 2012). In other words, the current official position of the Japanese government is that the PPP has to be used to deal with the damage caused by the accident. I will now describe the PPP.

III. The Polluter Pays Principle

From an economic perspective, pollution has long been considered a negative externality—a side effect of business operations for which the whole society rather than individual polluters must pay. Companies could release pollutants into the environment without fear that they would have to pay for the damage. For this reason, pollution was not included in production costs, which meant that the invention of less polluting methods of production was not incentivized by the market. The PPP is a way to resolve this problem and encourage companies to include the costs of pollution in their accounting and final product pricing.

Central to the PPP is the idea that the cost of pollution must eventually be covered by the person that caused it. The goal is not only to make companies pay for pollution damage (such as costs for cleanup or decontamination works),

but also to encourage them to find ways to prevent pollution in the first place, or at least to reduce it through cleaner business practices (Bayliss & Langley, 2003, pp. 8–9; Omar, 2008, p. 336).

Several issues arise when the PPP is applied, the main one being that companies can simply pass pollution control costs onto consumers by increasing the prices of their products (Narayana, 2011). To prevent that from happening, the market has to be competitive enough to allow consumers to switch to other similar products and create a higher demand for less dangerous substitutes (Louka, 2006, p. 449). In the case of electricity production in Japan, the existence of regional monopolies by utility companies means that consumers cannot choose one company over another. This allows TEPCO to raise electricity rates to offset pollution damage compensation claims. In such situations, the PPP can become the CPP—the Consumer Pays Principle.

The PPP first emerged as an international environmental norm in 1941 when the US won the Trail Smelter dispute against Canada. The smelter, which was located in the southern part of British Columbia, produced a large amount of smoke rich in sulfur dioxide that caused damage to surrounding agricultural lands and forests. Landowners across the Canada–US border complained about the pollution and eventually the company that owned the smelter had to pay compensation to the landowners to cover the damage (Hussen, 2004, p. 136).

Some decades later, the PPP was mentioned for the first time in a multilateral agreement signed at the Stockholm Conference in 1972. Article 21 of the Declaration on the Human Environment states that countries have to “insure that activities within their own jurisdiction or control do not cause damage to the environment of other states or areas beyond the limits of national jurisdiction.” In the same year, the Council of the Organisation for Economic Co-operation and Development (OECD) released the Recommendation on Guiding Principles for Economic Aspects of Environmental Policies, which provided a more detailed description of the PPP.

The principle to be used for allocating costs of pollution prevention and

control measures to encourage rational use of scarce environmental resources and to avoid distortions in international trade and investment is the so-called “Polluter-Pays Principle.” The Principle means that the polluter should bear the expenses of carrying out the above-mentioned measures decided by public authorities to ensure that the environment is in an acceptable state. In other words, the cost of these measures should be reflected in the cost of goods and services which cause pollution in production and/or consumption. (Article 4)

In 1975, the Recommendation was supplemented by a document that explains how the PPP has to be implemented (OECD, 1975). It states that the meaning of “pollution” and “acceptable state” of the natural environment must be defined by each state according to their individual characteristics and circumstances. In some cases, this is done by creating a regulation with a list of pollutants and their maximum allowed discharge to the environment, such as the Air Pollution Control Act in Japan, which regulates car exhaust emissions.

In other cases, instead of being specific about each pollutant, laws provide definitions of the types of environmental damage for which polluters must be responsible. In other words, it does not matter whether certain levels of pollution are breached; the most important issue is whether the pollutants caused any damage. An example of such a regulation is the Environmental Liability Directive (2004/35/CE) of the European Union (EU), which was adopted in 2004. It lists three types of damage to the natural environment: 1) damage to species and habitats; 2) damage to water; and 3) damage to land. The Directive defines pollution in terms of its effect on the environment and human health rather than asking whether the polluter adhered to specific levels of permissible contamination (Bergkamp & Goldsmith, 2013, pp. 32–6). As will be explained later and exemplified by the Minamata disease case, Japan also endorses this kind of regulation.

The PPP is now widely accepted at both the national and international level (Kiss & Shelton, 2007, p. 95; Larson, 2005; Sadeleer, 2002, pp. 21–33). It is

part of the 1985 ASEAN Agreement on the Conservation of Nature and Natural Resources; it was discussed during the Rio Conference in 1992 and included in the final declaration (“the polluter should, in principle, bear the cost of pollution”, Principle 16); it is one of the pillars of the environmental policies of the EU; and it is part of the national environmental laws of many developed countries.

In Japan, the first major applications of the PPP occurred from 1971 to 1973, when Japanese courts ruled in favor of pollution victims’ claims (Broadbent, 1999, p. 126). Among these victims were people suffering from Minamata disease, or acute mercury poisoning. The company that released mercury into the environment was ordered to cover the damage to the people who were found to have symptoms of Minamata disease. Despite the financial compensation some patients received in 1973, the process of deciding who was or was not a victim and how much compensation should be has been surrounded by controversy—even to this day—which shows that the implementation of the PPP is not a smooth process (George, 2001; Yoneyama, 2012).

With one exception, the PPP has not been applied on a large scale in Japan since the early 1970s. The lone exception is the current compensation mechanism for damage caused by radioactive pollution following the Fukushima accident.

IV. The PPP and the Accident in Fukushima

The first question that must be asked in the case of the Fukushima Daiichi nuclear power accident is, who is the polluter? The answer seems straightforward, TEPCO, the owner of the plant, which had to examine the possibility of such an event occurring and take all necessary steps to prevent it. Such responsibilities are supported by Article 3 of the Act on Compensation for Nuclear Damage adopted in 1961, which says that the company responsible for the plant in which an accident happens “shall be liable for the damage.” However, the Article adds that liability cannot be required “in the case where the damage is caused by a grave natural disaster of an exceptional character.”

Whether the Tohoku earthquake and tsunami fall under this clause was at the center of many discussions right after the disaster. Much to TEPCO's disappointment, the Japanese government took the stance that 3/11 was not an exceptional disaster, and on July 19, 2012, Tokyo District Court ruled that asking TEPCO to be responsible for the damage was a legal decision (Takano, 2012).

The next question is, what is considered the damage for which TEPCO must pay? As contamination by radioactive materials is excluded from environmental laws in Japan, such as the Air Pollution Control Law, the Soil Contamination Countermeasures Law, the Agricultural Land Soil Pollution Prevention Law, the Water Quality Pollution Control Law and others, there is no legal basis for defining radioactive pollution as damage in the existing laws (Mori, 2012). Therefore, the government adopted a set of *ad hoc* regulations, the Interim Guidelines on Determination of the Scope of Nuclear Damage, released in August 2011, which form the basis for the majority of current damage claims made by individuals and companies.

The following types of damage will qualify for compensation to a certain extent: damage that was a consequence of a government instruction, etc. issued on reasonable grounds to protect the life or health of citizens from the accident; damage arising through reasonable avoidance behavior in markets; and indirect damage necessarily arising in third parties as a result of these other two types of damage having arisen. (Part 2, Section 1)

In other words, damage is considered to originate mainly in government policies that had a negative impact on local people's lives, and changes of consumers' attitudes toward products made in Fukushima and other contaminated regions. In those cases in which local people decided to leave their homes or stop doing business voluntarily, any damage they suffered does not qualify for compensation because it did not result from something the government told them to do.

These differences in defining damage are also important for the forestry industry. Right after the accident, the government ordered people to evacuate from the most polluted areas and advised forest owners outside of the evacuation zone to suspend their activities because the level of radioactive contamination of forests was unknown. However, in the latter case, it was only an advisory, not a prohibition, so the government was not forcing the forest owners to alter their usual practices. Later, when it became clear that radiation exposure exceeded the acceptable artificial dose for members of the public (1mSv/year) in vast areas of forests, again the government did not require forestry activities to stop until radiation levels dropped below the acceptable limit (naturally or artificially). As a result, the forest owners who stopped their usual forestry work out of fear of radiation cannot ask for compensation because their damage was not a consequence of a governmental instruction.

However, there are other government regulations that are important in the context of forests. As Fukushima is an important producer of mushrooms in Japan, many forest owners supply small logs for farmers to grow shiitake and other types of mushrooms. In addition, sawmills sell tree bark and sawdust to be used in agriculture as compost or mulch. Because both of these uses of wood are directly related to food, more stringent radioactivity requirements are applied. There are numerous cases in which forest owners were not allowed to sell forest products because they exceeded existing limits. As these requirements were set by the government, such lost revenues should qualify as damage and be eligible for compensation. So far, a number of forest associations in Fukushima Prefecture have used this opportunity and made claims that they lost more than 43 million USD in revenues in 2011–2013 (Fukushima Minpo, 2013b; Fukushima Minyu, 2013).

Currently, there are not signs that timber itself is contaminated by radioactive materials to such a level that it could not be used for housing or other purposes. This is because only part of the cesium that fell in the forests was absorbed by trees, and only some of the absorbed cesium has penetrated into the deeper layers of the wood. Decontamination could help remove a

substantial amount of cesium from the forests and prevent it from being trapped in tree trunks. Delaying decontamination efforts could worsen the situation. According to research carried out in Chernobyl, radiation is constantly absorbed by trees and it reaches peak levels after 10 to 20 years (Tonosaki, 2013).

As already noted, the government has no plans to start large-scale decontamination of forests in Fukushima, except for forested land that is within 20 m of residential areas. Data collected by the MoE show that progress is slow; as of September 2013, only one-third of this type of land has been decontaminated (MoE, 2013b). As radiation in the rest of the forests is left to diminish naturally, we can expect forest owners to make repeated claims to be compensated for lost revenue until their forest products are proven to comply with safety regulations set by the state. The Interim Guidelines recognized the possibility of such a situation.

With respect to those types of damage that might arise on an ongoing basis, such as evacuation expenses, business damage, or damage due to incapacity to work, the criteria for determining an end date for these types of damage will present difficulties. [...] The Committee will examine those types of damage for which this is not the case at a future time as necessary, in keeping with how events progress. (Part 2, Section 2)

The way in which damage is currently defined reveals several limitations in the implementation of the PPP, the most serious one being that alternative ways of dealing with contamination fall outside of the official framework. For example, the people of Fukushima have expressed their support for forest decontamination works and submitted written demands to the MoE to begin decontamination work (Higa, 2012). However, their demands were denied, as forests are currently at the bottom of the priority list. Clearly, this is not consistent with the PPP, as the owners of polluted forests should be able to demand that TEPCO pay for cleaning up the contaminants. In fact, TEPCO is already paying for the decontamination of both private and public spaces in

Fukushima. Nevertheless, it is not fair that forest owners must wait; some of them may have to wait so long that their forests could become clean naturally due to radioactive decay. Allowing polluters to postpone their liability for several years should not be acceptable if the PPP is to be applied.

Another limitation is that, to be compensated for lost revenues, forest owners must conduct their usual forest activities in contaminated forests, which might be detrimental to their health. This is because a claim for lost revenue can only be made if the final product is found to have radioactivity higher than allowed levels. Even more than two and a half years after the accident, there are still no official criteria regarding how forest owners can evaluate their forests for compensation. In other words, people in the forestry industry face a dilemma: to continue their usual business in contaminated forests and be compensated for production that is not fit for consumption, or stop their business and face the possibility that they might not be compensated at all. Even if forest owners choose the first option and their products are refused, they have to store them somewhere, as there are no set rules about how to dispose of such products and who should pay for the disposal. For example, different facilities that belong to Fukushima's forest associations have accumulated tens of thousands of tones of radioactive tree bark and they are worried about whether, in addition to lost revenue, they will be compensated for the cost of storing the material (Fukushima Minpo, 2013a).

The third limitation is that the existing implementation of the PPP is restricted to economic activities and does not cover broader damage to the forests and their users. As many people in Fukushima live in close proximity to forests, they collect wild forest plants and mushrooms for their personal use, or they use forests for recreational purposes. Fear of radioactive contamination or official warnings in some areas (Asahi Shimbun, 2013; Shimada, 2013) to refrain from eating and selling wild plants and spending time in forests has prevented many people from going into the forests. Although TEPCO should be held responsible for such negative consequences, they are not included in the definition of damage set by the government.

These three limitations show that the current application of the PPP does not fully cover pollution damage and that the official regulations set by the Japanese government reduce TEPCO's liability to the forest owners and the residents of Fukushima in general. People who feel they were damaged by the accident, but whose cases are not covered by the compensation guidelines, can submit their case to the court. This has been done by people who voluntarily left their homes because they feared that radiation might have a negative effect on their family members, especially their children. However, the outcome of such litigation is not clear and the process is costly. As a result, the forest owners have to hope that their situation is not simply forgotten by the state and that all losses will be justly compensated in the future.

V. Conclusion

The forestry industry in Fukushima is in a difficult position because of the radioactive contamination that was spread over large areas during the accident. Forests inside the evacuation zone can neither be used for timber production nor properly maintained. Because forests are being undermanaged, there are fears that they will lose both their economic value and their ecological value (such as preventing landslides). Meanwhile, outside the evacuation zone, the forestry industry has been damaged by warnings about radioactive pollution, tests that showed that their products were not suitable for consumption, and distrust among consumers about the safety of Fukushima's forests, all of which has led to a drop in prices.

There is no quick and easy way to repair the damage. Although the government has declared that TEPCO is liable for the financial costs of the accident, it has made regulations that leave the nuclear power plant owners only partly responsible for economic damage. As a result, forestry issues are not on an equal footing with issues concerning human environments or agriculture. More than two and a half years after the accident, there are still no criteria about how damage to standing forests can be evaluated, no plans to start decontamination, and no flexibility for individual forest owners to decide which

type of damage restoration is appropriate for their forest.

The situation in Fukushima raises broader questions about how the PPP can be implemented in large-scale accidents, or whether its implementation is feasible at all in such cases. As TEPCO already finds itself in a very difficult financial position, implementing a comprehensive compensation mechanism for forest damage may well be too much for the company to manage; the outcome would be that costs for pollution damage are eventually paid by the forest owners themselves or covered by taxpayers' money. If that occurs, the difficulty in applying the PPP in Fukushima's case will be an additional strong argument against the use of nuclear power.

References

- Asahi Shimbun. (2013, June 2). Request for self-imposed shipping restrictions for wild koshiabura (Yasei koshiabura no shukkajishuku o yōsei). *Asahi Shimbun*, p. 25.
- Bayliss, C., & Langley, K. (2003). *Nuclear Decommissioning, Waste Management, and Environmental Site Remediation*. Butterworth-Heinemann.
- Bergkamp, L., & Goldsmith, B. (2013). *The EU Environmental Liability Directive: A Commentary*. Oxford University Press.
- Broadbent, J. (1999). *Environmental Politics in Japan: Networks of Power and Protest*. Cambridge University Press.
- Fukushima Minpo. (2013a, March 10). We want to protect rich forests: the struggle of the timber industry (Yutaka na shinrin mamoritai: mosaku suru mokuzai sangyō). Retrieved September 11, 2013, from http://www.minpo.jp/pub/topics/jishin2011/2013/03/post_6599.html
- Fukushima Minpo. (2013b, July 20). Claim for 3 billion 447 million yen compensation (34 oku 4700 man en baishō seikyū).
- Fukushima Minyu. (2013, January 18). 65.8% of forest compensations authorized, TEPCO is demanded to improve (Shinrin baishō ninte wa 65.8%, Tōden ni kaizen yōbō).
- Fukushima prefecture. (2010). Outlook of forests and forestry in Fukushima prefecture (Fukushima-ken no shinrin ringyō no gaikyō). Retrieved September 6, 2013, from http://www.cms.pref.fukushima.jp/download/1/shinrinkeikaku_toukeisyō22_5.pdf
- Fukushima prefecture. (2013). Guide for stable provision of woody biomass in Fukushima

- (Fukushima-ken mokushitsu baiomasu antei kyōkyū no tebiki). Retrieved September 6, 2013 from http://www.cms.pref.fukushima.jp/download/1/ringyoushinkou_biomass_tebiki.pdf
- George, T. S. (2001). *Minamata: Pollution and the Struggle for Democracy in Postwar Japan*. Harvard University Asia Center.
- Hashimoto, S., Linkov, I., Shaw, G., & Kaneko, S. (2012). Radioactive Contamination of Natural Ecosystems: Seeing the Wood Despite the Trees. *Environmental Science & Technology*, 46(22), 12283–12284.
- Hashimoto, S., Ugawa, S., Nanko, K., & Shichi, K. (2012). The total amounts of radioactively contaminated materials in forests in Fukushima, Japan. *Scientific reports 2*, Article number: 416
- Higa, H. (2012, August 15). Forest decontamination: towns and villages in Fukushima prefecture submit written request to the Ministry of Environment (Shinrin josen: Fukushima-ken to chōsonkai, kankyōshō ni yōbōsho). Retrieved September 14, 2013, from <http://financegreenwatch.org/jp/?p=15431>
- Hiroshi, I. (2013, March 2). Declining radiation measured near Fukushima plant, some blown elsewhere. *Asahi Shimbun*. Retrieved September 8, 2013, from <http://ajw.asahi.com/article/0311disaster/fukushima/AJ201303020041>
- Hussen, A. M. (2004). *Principles of Environmental Economics*. Routledge.
- International Atomic Energy Agency. (2011). Final Report of the International mission on Remediation of large contaminated areas off-site the Fukushima dai-ichi NPP. Retrieved September 4, 2013, from http://www.iaea.org/newscenter/focus/fukushima/final_report151111.pdf
- Japan Atomic Energy Agency. (2012). Decontamination Model Projects to Establish Guidelines of Municipal Remediation Work for Residential Areas Contaminated with Radioactive Materials Discharged from the Fukushima Daiichi Nuclear Plant. Retrieved September 5, 2013, from http://jolisfukyu.tokai-sc.jaea.go.jp/fukyu/mirai-en/2012/1_7.html
- Kawasaki, K. (2012). Current status of municipal planning activities in Fukushima Prefecture: Special Focus on Non-statutory Municipal Decontamination Plans. *Proceedings of the International Symposium on Engineering Lessons Learned from the 2011 Great East Japan Earthquake*. Retrieved September 9, 2013, from <http://www.jaee.gr.jp/event/seminar2012/eqsympo/pdf/papers/13.pdf>
- Kirino, K. (2011, May 30). Fukushima Daiichi nuclear power plant: ongoing crisis in forestry (Fukushima Daiichi genpatsu: ringyō, sonzoku no kiki). *Mainichi Shimbun*. Retrieved September 13, 2013, from <http://financegreenwatch.org/jp/?p=2201>
- Kiss, A. C., & Shelton, D. (2007). *A Guide to International Environmental Law*. BRILL.
- Larson, E. T. (2005). Why Environmental Liability Regimes in the United States, the European

- Community, and Japan Have Grown Synonymous with the Polluter Pays Principle. *Vand. J. Transnat'l L.*, 38, 541.
- Little, J. B., & Bird, W. A. (2013). A Tale of Two Forests: Addressing Postnuclear Radiation at Chernobyl and Fukushima. *Environmental Health Perspectives*, 121(3), 78–82.
- Louka, E. (2006). *International Environmental Law: Fairness, Effectiveness, and World Order*. Cambridge University Press.
- Maeda, M. (2011, November 24). No one's responsibility (Mujoyubutsu no sekinin). *Asahi Shimbun*, p. 3.
- Ministry of the Environment. (2011). Decontamination Policies and Procedures in Japan. Retrieved September 14, 2013, from http://josen.env.go.jp/en/documents/pdf/documents_02.pdf
- Ministry of the Environment. (2012). Outline of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials. Retrieved September 14, 2013, from http://josen.env.go.jp/en/pdf/annex_01.pdf
- Ministry of the Environment. (2013a, September 15). Off-site Decontamination Measures. *Off-site Decontamination Measures*. Retrieved September 22, 2013, from <http://josen.env.go.jp/en/>
- Ministry of the Environment. (2013b, September 20). Outline and progress of decontamination works (Josen jisshi no gaiyō, shinchoku). Retrieved September 20, 2013, from <http://josen.env.go.jp/zone/index.html>
- Mori, K. (2012). Traps in Sustainable Development Governance: Reflection on the Fukushima Crisis for Rio+ 20. *The Journal of Social Science* (International Christian University), (73), 5–27.
- Munro, A. (2012). *Fukushima Dai-Ichi and the Economics of Nuclear Decontamination*. National Graduate Institute for Policy Studies. Retrieved September 15, 2013, from <http://r-center.grips.ac.jp/gallery/docs/12-01.pdf>
- Narayana, T. (2011). The Ethical Basis of Environmental Law. In H. Gèokòckekuòs, U. Tèurker, & J. W. LaMoreaux (Eds.), *Survival and Sustainability: Environmental concerns in the 21st Century*. Springer.
- Organisation for Economic Co-operation and Development. (1975). *The Polluter Pays Principle: Definition, Analysis, Implementation*. OECD Publishing.
- Omar, P. J. (2008). *International Insolvency Law: Themes and Perspectives*. Ashgate Publishing, Ltd.
- Sadeleer, N. de. (2002). *Environmental Principles: From Political Slogans to Legal Rules*. Oxford University Press.
- Shimada, H. (2013, June 14). Slow revival and hesitation to rebuild (Fukkō chichi, saiken ninoashi). *Asahi Shimbun*, p. 38.
- Takano, R. (2012, July 20). Tokyo district court decides the earthquake was not an exceptional

natural disaster and that requirement for TEPCO to be responsible for compensations is “legal” (Genpatsujiko, Tōden no baishō sekinin “tekihō” handan: Tōkyō chisai “shinsai wa ijyōtensai denai”). *Asahi Shimbun*, p. 38.

Tonosaki, M. (2013). Migration of radioactive cesium to timber and safety of using wood products (Mokuzai e no hōshasei seshiumu ikō to anzen na mokuseihin ri'yō). *Trends of Science (Gakujyutsu no dōkō)*, 6, 80–81.

Valentin, J. (2007). The 2007 Recommendations of the International Commission on Radiological Protection. *ICRP publication, 103*. Retrieved September 14, 2013, from <http://nuclear.com/archive/2012/12/04/ML12338A682.pdf>

Yoneyama, S. (2012). Life-world: Beyond Fukushima and Minamata. *The Asia-Pacific Journal: Japan Focus*, 10(42)(2). Retrieved September 11, 2013, from http://asiapacific.anu.edu.au/researchschool/events/annual_conference/2012/Life-world-Yoneyama-2012.pdf

Radioactive Contamination of Fukushima's Forests: Application of the Polluter Pays Principle

<Summary>

Linas Didvalis

The forestry industry in Fukushima is in a difficult position because radioactive contamination was spread over large areas during the accident at the Daiichi nuclear power plant. Forests inside the evacuation zone cannot be used for timber production, nor can they be properly maintained. Outside the evacuation zone, the forestry industry has been damaged by warnings about radioactive pollution, tests that showed their products were not suitable for consumption, and distrust among consumers about the safety of Fukushima's forests, all of which has led to a drop in prices.

There is no quick and easy way to repair the damage. Although the government has pledged to implement the Polluter Pays Principle (PPP) by declaring that the Tokyo Electric Power Company (TEPCO) is liable for the financial costs of the accident, governmental regulations only require the owner of the nuclear power plant to be responsible for certain economic costs, with the rest to be left for future consideration. As a result, forestry concerns are not on an equal footing with human environments or agriculture. Two and a half years after the accident, there are still no criteria for how to evaluate damage to standing forests, no plans to start forest decontamination, and no flexibility for individual forest owners to decide which type of damage restoration is appropriate for their forest.

In this article, I argue that implementation of the PPP for the radioactive

contamination of Fukushima's forests has several major limitations. These limitations must be overcome if just compensation is to be made to the forest owners, workers in the forestry industry, and the residents of Fukushima. However, as TEPCO already finds itself in a very difficult financial position, implementing a comprehensive compensation mechanism for forest damage may well be too much for the company to manage; the outcome would be that pollution damage compensation is eventually paid by the forest owners themselves or covered by taxpayers' money. If that occurs, the difficulty in applying the PPP in Fukushima's case will become an additional strong argument against the use of nuclear power.

