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Contaminated forests: Management after Chernobyl and Fukushima

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Deep in the forested mountains of Fukushima Prefecture, in the town of Kawauchi, a woman in an apron and skirt stands in front of her house, solemnly scrutinizing her property. A group of workmen, crouched nearby drinking their afternoon tea, have cleared the property of all underbrush and grass. Beyond them a dry brown expanse slopes 20 meters up the hillside, its trees now branchless trunks poking upward between fresh-cut stumps.

The woman is one of thousands of residents and temporary workers who are using chainsaws, bamboo rakes, and their own hands to remove leaf litter, undergrowth, and trees from the periphery of houses and other buildings throughout the eastern part of the prefecture. Their target is anything that might harbor contamination from the March 2011 meltdown of three reactors at the Fukushima Daiichi Nuclear Power Station. Japanese officials believe that

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scouring the land will rid it of radionuclides so that evacuees can safely move back home. But while decontamination has already been declared finished in one town within the exclusion zone and is under way in others, vast stretches of heavily forested mountains—up to 86 percent of the land in some districts near the plant—are proving a major obstacle in the government's cleanup and resettlement plan.

At Chernobyl, Ukraine, the site of the only nuclear accident worse than this one, government officials have taken an entirely different approach (http://ehp.niehs.nih.gov/121-a78/) to managing irradiated forests. After Chernobyl's No. 4 reactor exploded in 1986, sending radionuclides aloft as far as Sweden and Finland, officials completely evacuated 2,600 square kilometers. In this area, known as the exclusion zone, forests now cover 87 percent of the land. Left to themselves, the abandoned forests and fields trapped cesium, plutonium, strontium, and other airborne radionuclides through their natural life cycle: Contamination-coated leaves and needles dropped to the ground, where they became part of the litter and gradually migrated into the soil. In 2006, scientists found that up to 96 percent of all radionuclides remaining in the forests were concentrated in the soil, mostly in the top 10 centimeters.

Cesium around Fukushima is also migrating from trees and leaves into the soil. When scientists at the government-funded Forestry and Forest Products Research Institute surveyed the distribution of radiocesium at three forested sites in the fall of 2011, they found between a third and half of contaminants were in the leaf litter. Removing these fallen leaves, they suggested, would be a relatively efficient way to clean up forests. By the time the researchers re-tested the same three sites a year later, however, contaminants had shifted dramatically downward: Between 65 and 77 percent of radiocesium was in the soil, where it is much more difficult, expensive, and environmentally harmful to remove.

While officials in Japan grapple with these issues, their counterparts in Ukraine are struggling with one of the consequences of their decision to let nature take its course in the Chernobyl exclusion zone: fire (http://wwwp.dailyclimate.org/tdc-newsroom/2013/06/chernobyl-forest-fire). If these forests burn, strontium-90, cesium-137, plutonium-238, and other radioactive elements would be released, scientists say. And

instead of being emitted by a single reactor, the radioactive contamination would come from trees covering a vast area. A worst-case-scenario study conducted in 2011 predicted that people living outside the exclusion zone would not have to be evacuated, and there would be no cause for panic in Kiev. But firefighters would be exposed to radiation beyond acceptable levels. In addition to external radiation, they would be exposed to internal radiation by inhaling radionuclides in the smoke.

Forest scientists in Japan say the risk of catastrophic forest fires in Fukushima is relatively low compared with Ukraine, and limited to a short dry season in spring. Nevertheless, the Chernobyl data present yet another dilemma for Japanese officials and forest residents.

As the sites of the world's worst nuclear power plant accidents, Japan and Ukraine share the challenge of protecting their citizens even as they hope to return residents to the rural communities where forests sheltered and nurtured them. Whether Japan opts for the Chernobyl model, leaving forests to their slow but natural recovery, or pursues decontamination, local residents will inevitably pay a price.

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far from a fault line, and so a sufficiently big earthquake could give the Islamic Republic its very own Chernobyl/Fukushima.

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David Ropeik • a month ago

There is unfortunately nothing here about levels of radioactivity, which is CENTRAL to the level of risk that may exist. Nor is there any mention of decay, since radionuclides become stable and "no longer 'active' with time, within a few decades in the case of many elements in the Chernobyl fallout. That is also critical to the overall question of what, if any, the risk may be.

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Winifred Bird → David Ropeik • a month ago

That's a good point, David. Radiation levels do, of course, determine risk for the population, and they do fall over time due to natural decay. In some cases, the dissipation is beyond human lifetime. Although radiation from iodine-131 falls by half in just eight days, the half-life of cesium-137 is 30 years; for plutonium-239 it’s 24,100 years.

In Fukushima in September 2011 air dose rates were predicted to exceed 20 mSv/y in 42,000 hectares of forest, and 1 mSv/y in 430,000 hectares, according the Japan's Ministry of the Environment. (The ICRP recommends governments set the limit for acceptable exposure for the general public following a nuclear accident at between 1 and 20 mSv/y.) In a cedar forest in Kawauchi, air dose rates measured 3.11 microsieverts per hour in 2011, and had fallen to 3.01 a year later. Over the same period overall concentrations of radiocesium in forest material and soil fell slightly, from 1,230 kBq/m2 to 1,070 kBq/m2, according to the FFPRI study mentioned in the above article.

Some scientists and officials say that except in areas very close to the plant, these levels do not pose a great health risk to nearby residents - especially because most spend only limited time in forests. The fact remains, though, that many residents still feel very worried about the forests near their homes, be it concern over contaminated runoff in their drinking water and rice fields, wild mushrooms they are afraid to eat, or

just the fear of spending time in contaminated woods that keeps them from taking their children outside to play. Policy is - and must be - based not only on scientific assessments of risk but also on resident's assessments of what they can live with.

In Ukraine, despite the passage of 27 years, the Chernobyl Exclusion Zone is still one of the most contaminated places on the planet. Levels of cesium-137 in exclusion zone soils vary from around 37 kBq/m2 (the threshold for hazardous contamination used by Soviet authorities) to 75,000 kBq/m2 in a random pattern that reflects the haphazard releases of radionuclides during the 10-day event in 1986.

The remaining radionuclides are, as you suggest, relatively stable and concentrated primarily in the soils of the forests and former fields. The worry is that they would be released in the event of wildfire. A 2011 study found that a catastrophic wildfire in the Ukrainian portion of the CEZ that completely consumed the vegetation and litter in these areas could release approximately 4×1014 Bq of radioactive material. The nuclides of concern are: 90Sr, 137Cs, 154Eu, 238Pu, 239,240Pu, and 241Am.

Such a worst-case event, unlikely in reality, would expose adults 100 km away (the approximate distance to Kiev) to 3.5 mSv during the first year after the event. Ingestion, which the scientists consider the most serious pathway of exposure, would add 5.9 mSv during that first year. For children, the equivalent figures are 1.6 mSv and 5.5 mSv.

We thank you for your comment and hope this helps clarify the issues you raise.

- Winnie and Jane

Reply Share ›

David Ropeik ➚ Winifred Bird • a month ago

Winifred, Jane (HI Jane!)

Thanks for those details. I think they add important info that would help the reader make a more informed judgment about just

how risky/dangerous things are, for either people or the environment. I think back to my reporting days and how often I failed to include important elements of 'risk' that I only realized when I joined the Harvard School of Public Health were really critical; dose, routes and duration of exposure...that kind of stuff. And not only the does itself, but what levels do what...the details of the hazard itself. I would so often report that there is this 'bad' hazardous thing out there, and never report on how much of that bad thing it takes to do harm, and what harm does it do. Turns out with ionizing radiation, we know from the A bomb survivors that it causes some forms of cancer, but only raises the risk of getting those cancers a tiny amount, even at much higher doses, and at the exposures most people got around Chernobyl (~30 mSv/y) no health damage that can be detected against normal disease rates. I stumbled across that info when I wrote my first book, and it stunned me, and really conflicted with the scary stuff about radiation I believed.

So all of that is why I commented. Hope I didn't sound snotty. Best of luck with all the ways your project is going to produce material. I look forward to reading more. (PS. do you know a guy at Colorado State named Tom Borak, or a Ward Whicker. Just heard them speak on radioecology. Borak's kind of the father of the field. They had lots to say on the Chernobyl enviro effects...for what that's worth. http://www.colostate.edu/Depts...

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jimmy2 ➚ David Ropeik • 19 days ago

You do sound a little dismissive to me. I would just add a bit. The ABCC reports came out at a time when the prevailing wisdom was that alpha emitters weren't very penetrating so it was ok to build schools on landfill made up of uranium tailings and to build office buildings out of aggregate made from the same source, a couple of radically bad ideas. Alpha emitters later came under very controversial scrutiny as internal sources associated with

controversial scrutiny as internal sources associated with plutonium workers and not coincidentally with uranium miners. One explanation of the low numbers in the ABCC at high exposure rates reappeared in the alpha-emitter data. Above certain exposures most of the individuals--or cells--don't get sick; they die. That's not really reassuring.

In the end, the only people in such controversies who cannot bow out at the boundary of their intellectual specialty are the everyday folks who have to live with what are mostly other people's decisions. This article takes the very wise and seldom-articulated position that "Policy is - and must be - based not only on scientific assessments of
risk but also on resident's assessments of what they can live with." The numbers certainly help to clarify the picture, but nothing can replace a respectful attitude.