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Food Safety: Addressing Radiation in Japan's Northeast after 3.11

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Summary: This article provides observations from the consumer perspective on food safety in the wake of the Great East Japan earthquake tsunami and nuclear disaster of March 11, 2011.

The human and environmental effects of the extraordinary catastrophe on March 11, 2011 in northeastern Japan are difficult to assess even as four months have passed since the 9.0 earthquake and tsunami. This is in part because the crisis at the Fukushima Daiichi Nuclear Plant is ongoing, with radiation leaking from at least four reactors requiring evacuation of areas in Fukushima prefecture and beyond, and restrictions on food grown and produced in certain areas. It is a humanitarian disaster that affects all citizens in the Tohoku region, but specifically its farmers, fishermen and food producers; for consumers, it also poses specific challenges that need to be addressed based on what we know so far.

Testing of food at a public hall in Fukushima city, Japan

This paper will deal with general food safety issues in the wake of the crisis. What can be concluded about the general level of safety or risk, looking at it from the perspective of consumers?

Safety Standards

Setting safety standards or levels for radioactive substances in food is a task that gained great attention after the Chernobyl accident in 1986.[1]

There are international standards agreed upon by the FAO/WHO Codex Alimentarius Commission, geared to facilitate trade in food. Codex calls them "guidance levels" rather than "safe levels", while Japan officially calls them "provisional regulation values."

Countries may and do set national standards that are higher or lower than the Codex standards, depending on specific intake variations of local food and cultural preferences. After Chernobyl, the main European concern was with grazing cattle, sheep, and reindeer. In Japan, by contrast, people consume large quantities of rice, vegetables and fish. Thus, the country may decide to set more strict safe levels for such foods, as total exposure will be higher than in a country with other dietary traditions and preferences.

Japan had no guidance levels or restrictions for nuclear substances on food at the time of the nuclear disaster. It raced to draw up provisional regulation values by March 17[2] and legislation by March 29, 2011.

Radiation exposure limits for food

	Iodine-131 (Becquerels/kg)				Cesium-134 + Cesium-137 (Bq/kg)				
	Drinking water	Milk + dairy products	Vegetables (excluding root vegetable + potatoes)	Others	Drinking water	Milk + dairy products	Vegetables	Grains	Meat, eggs, fish, others
Japan	300	300	2,000	Seafood 2,000	200	200	500	500	500
Codex*	100	100	100	100	1,000	1,000	1,000	1,000	1,000
Singapore	100	100	100	100	1,000	1,000	1,000	1,000	1,000
South Korea	300	150	300	300	370	370	370	370	370
China	—	33	160	Meat + seafood 470 grains 190 potatoes 89	—	330	210	260	Meat, fish, crustaceans 800 potatoes 90
Taiwan	300	55	300	300	370	370	370	370	370
Philippines	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
USA	170	170	170	170	1,200	1,200	1,200	1,200	1,200
EU	300	300	2,000	2,000	200	200	500	500	500

*Codex is a U.N.-affiliated commission that sets food standards to protect the health of consumers and ensure fair trade.
SOURCE: The Agriculture, Forestry and Fisheries Ministry

Japan's Food Safety Commission (FSCJ) notes:

> "Due to this radiation leakage, from the perspective of the Food Sanitation Act, which aims to prevent sanitation hazards resulting from eating and drinking, the "Indices relating to limits on food and drink ingestion" indicated by

the Nuclear Safety Commission of Japan was adopted for the time being as provisional regulation values. So the foods which exceed these levels are regulated to ensure those foods are not supplied to the public to eat, and local governments have been notified by the Ministry of Health, Labour and Welfare on 2011 March 17. This provisional regulation values [sic] were adopted without an assessment of the effect of food on health by FSCJ because of its urgency, therefore on 2011 March 20, the Minister of Health, Labour and Welfare requested FSCJ for an assessment of the effect of food on health."[3]

The safety levels in Japan are generally similar to values in other countries, and identical to those of the 26 member countries of the European Union. The exposure limit for Caesium-134 plus Caesium-137 in drinking water and milk is 200 Bq/kg in Japan and the EU, while the US has settled on a higher level (1,200 Bq/kg). Also, in foods such as vegetables, grains and meat, Japan and the EU has a limit of 500 Bq/kg while the US has a limit of 1,200 Bq/kg. Whether or not the public in Japan is exposed to levels above these limits is not clear at this point and needs to be investigated further.[4]

Some of the results of the radiation testing event in Fukushima city, Japan

The main isotopes being measured in Japan are radioactive Iodine and Caesium, but other substances like Plutonium and Strontium are also relevant and should be measured carefully. It is unclear which radioactive isotopes were tested for or detected in the early days of the crisis. The method of sampling at the local level is still sometimes unclear and needs to be further investigated by independent experts to increase consumer trust in the process.

The initial data published by the government showed extraordinarily high levels of Iodine-131 on vegetables such as broccoli, spinach, parsley and celery in many locations in several prefectures, especially in Fukushima[5], but also in Ibaraki[6] and Chiba[7]. Raw milk was tested and found to have slightly elevated levels in all parts of Fukushima with levels above the safe levels in certain areas[8, 9] and slightly elevated levels in Saitama and Gunma,[10] but not nearly as high as in Fukushima.

Note that such food products are not for sale. In all the cases where detected levels were found to be higher than the government's provisional regulation values, the foods have been prohibited from being placed on the market. Hence, no milk from the places where high levels were measured is allowed to be sold four months after the crisis. This does not mean that all food products with high levels have been kept away from consumers; some was shipped before testing was initiated, or from areas in which contamination was not initially recognized. The possibility remains that vegetables or milk from areas that have not yet been tested were put on sale. That does not mean that the public has been exposed to unsafe amounts of contamination, as the exposure would appear to be for a short time only, especially in the case of spinach or broccoli harvested in mid-March in the most heavily contaminated areas in Fukushima prefecture.

Efforts to urge consumers to support farmers in the Tohoku region, both through special marketing events and by commercial groups that sell directly to members, have certainly led to short-term exposure among consumers. One such effort that seems to require particularly thorough testing and measurement is the "Cheer Up by Eating" boxes sold by Daichi wo Mamoru Kai, a Chiba-based company, with produce sourced directly from selected farmers in the Tohoku region.[11, 12]

Three to four months after the initial release of radioactivity, high levels of radioactive Caesium were still found in a few products, mainly takenoko (bamboo shoots) and shiitake mushrooms, and these levels do not appear to be decreasing. Most such contamination is confined to certain areas in Fukushima prefecture, especially areas directly north and northwest of the Fukushima Daiichi Nuclear Plant. But these areas are not limited to Fukushima. For example, Tome city in Miyagi prefecture was identified as a hot spot when rice straw from that area was discovered to have high levels of radioactive Caesium which was shipped to a number of cattle producers.[13]

Caesium isotopes have a long half-life, 2 years for Caesium-134 and 30 years for Caesium-137. It is thought that the two isotopes have been released in approximately equal proportions. This will have consequences for rice production, and the rice harvest later in 2011 should be carefully monitored. It is worth noting that levels of radioactive Iodine have mostly decreased to levels that cannot be detected, which is consistent with expectations, as its half-life is 8 days.

Beef from cattle raised on hay and rice straw exposed to very high levels of radiation (having been stored outdoors) at farms in Minami Souma city in Fukushima, which is just north of the nuclear reactors, was found to have elevated levels of Caesium.[14]

On April 19, the Ministry of Agriculture, Forestry and Fisheries (MAFF) ordered some 20,000 meat cows and dairy cows inside the evacuation zone to be moved to other parts of Japan, but it is unclear how successful this policy has been. By mid-July, the number of cases of cattle suspected of radioactive contamination had reached over 1,300.[15]

The Japanese government ordered so-called mercy killing of cattle inside the evacuation zone up to 20 km radius from the Fukushima Daichi Nuclear Plant, but only on a voluntary basis. In Europe, the culling of grazing animals such as reindeer was made mandatory after the Chernobyl disaster. In Sweden, for example, over 70,000 reindeer were killed after testing revealed elevated levels of Caesium in the meat.

It is obvious that livestock in Fukushima must be monitored much more closely than first thought, and wild game from the region is very likely contaminated to a large extent. Although we now know which areas that need special attention, four months after March 11, there is great concern that Japan's government has not acted rapidly enough to protect consumers. Meanwhile, some desperate food producers, who take short-cuts in order to sell their produce quickly to avoid loss of their crops or livestock are undermining the efforts of others.

Regarding fish and seafood, large amounts of radioactive substances have been released into the Pacific Ocean. This contamination is observed in the measurements done on fish and seafood along Japan's Pacific Ocean coast. Three to four months after the initial release, and most likely also due to continued release in the course of these months, low levels of both Caesium-134 and Caesium-137 have been found in a large number of samples, ranging from salmon in Hokkaido,[16] mackerel in Chiba prefecture,[17] and other

types of fish and seafood products in Iwate, Miyagi and Fukushima prefectures.[18] In most cases where sampling has been undertaken, however, no radioactive substances have been detected, or the levels are well below than the government standards.

The contamination of inland waterways (and possibly lakes) appears to be serious. On June 23, 2011, high levels of Caesium were detected in five samples of river fish out of 36 investigated near the Fukushima Daiichi Nuclear Plant. The fish with levels above the safe levels had been caught in Mano River and Niida River in Minami Souma city and in Abukuma River in Date City. The levels revealed through testing of Ayu sweetfish were 1,600 Bq/kg of Caesium-134 and 1,700 Bq/kg of Caesium-137 caught in Mano River on June 18, 2011, and 2,100 Bq/kg of Caesium-134 and 2,300 Bq/kg of Caesium-137 in Niida River, both in Minami Souma city. The levels were 580 Bq/kg of Caesium-134 and 680 Bq of Caesium-137 in the case of Abukuma River in Date city, also in Fukushima prefecture.[19]

For tea, high levels of Caesium-134 and Caesium-137 were found in Gunma prefecture[20] and in Chiba and Kanagawa[21] prefectures. The nation's largest tea producing region in Shizuoka prefecture, some 300 km southwest of the Fukushima Daiichi Nuclear Plant, has also found elevated levels of radioactive substances in its products.[22]

The Shizuoka Prefectural Government called for shipment restraint and voluntary recall of the concerned tea sources. However, according to research conducted by Shizuoka Tea Research Center, "when brewed for drinking, the radioactive cesium level significantly drops (1/85) and therefore does not present any negative health influence." It is unclear how Caesium-134 and Caesium-137 have accumulated on or in tea leaves, and why it took so long for tests to reveal the contamination. It is also important that tests be done on tea for other radioactive nuclides.

Criticism of Testing

How satisfactory is the methodology of the tests? We note that none of the figures published by the Ministry of Health, Labor and Welfare (MHLW) are explained or rigorously presented. Greenpeace, the anti-nuclear environmental organization, calls on Japan to improve its testing regime and use the more sophisticated monitors that were used by European governments after Chernobyl.[23]

Simply put, the data as presented on the government's website would not stand up to peer review for an academic paper. We desperately need detailed studies, however, these should be done by experts with a background in food safety science and consumer protection. Consumers are still left wondering if testing has been done on the foods that are actually in shops or supermarkets, or if testing is limited to the production stage.

So far, no independent organization or research institute has published any real in-depth analysis of the Japanese government's data, and frankly we are at a loss regarding conditions in certain areas, especially in Fukushima prefecture. The data is sparse and incomplete even after three to four months. It is not presented on the official websites in a way that is easy to search or understand. One independent website that provides such useful service by presenting data in a more easily accessible way is the ATMC.jp website.[24]

Unsystematic sampling methodology means we do not have a clear grasp of how the levels of radioactive contamination have decreased, for example in the case of Iodine, with its 8-day half-life, on products such as broccoli and spinach. Consequently, and for many other reasons related to the mishandling of the nuclear crisis since March 11, some consumers feel that they cannot rely on the official data.

Radiation detection in food requires special equipment

Japanese citizens are responding to this by taking matters into their own hands. One example of an activity at the local level in Fukushima prefecture is the use of a sophisticated device (LB200) kindly provided by the Commission de Recherche et d'Information Indépendante sur la Radioactivité (CRIIRAD), who visited Japan and Fukushima from May 24 to June 3, 2011 in a joint effort with a group of Japanese citizens. This equipment is now being used by citizens who have been trained by CRIIRAD experts to test their own food.[25]

CRIIRAD findings generally confirmed the data as published by the Japanese government. But they also conducted detailed soil analysis that gives rise to concern. CRIIRAD has criticized the initial response of the government:

"The Japanese authorities adopted consumption restrictions within the FUKUSHIMA prefecture only on March 21st and 23rd (according to food types). Populations therefore consumed, for a period of over a week, extremely contaminated foods without any restriction notice and with no information. **They may have therefore received effective doses of several dozens milliSieverts (and even more) and doses to the thyroid gland exceeding the Sievert.**" [Emphasis in original][26]

Other Health Risks

Other pollution in addition to radioactive nuclides is entering the food chain in the wake of the earthquake tsunami, posing completely different risks to consumers. Chemical factories, oil refineries, and other petrochemical industrial complexes were destroyed or seriously damaged along the entire 400 km coast of Tohoku from Iwate and Miyagi to Fukushima, Ibaraki and Chiba. The large number of fires immediately after the earthquake and tsunami as well as indiscriminate burning of debris and garbage will have health effects that are very difficult to estimate. Data is not yet available from systematic testing of the substances such as asbestos or dioxins that were released into the air and water after March 11, 2011. Indeed, testing of air quality, public water areas, groundwater, soil, seafloor, and tsunami sediment is still in the planning stages.

The burning of a large, open-air pile of debris as part of the clean-up effort in Minami Sanriku harbour could be observed by this author on July 9, 2011. Thick, black smoke and a smell associated with burning plastic was observed and experienced. There appeared to be no effort by anyone, be it government officials or private initiatives, to monitor the airborne pollutants. Concerns about similar fires have been voiced by Bird and Grossman in their very important article in *Environmental Health Perspectives*.[27]

Bird and Grossman note: "Such fires have great potential to emit additional hazardous contaminants such as dioxins. These known human carcinogens result from incomplete burning of PVC, which is used extensively in wiring, construction materials, and numerous other consumer, industrial, and infrastructure applications. Dioxins can also be produced by burning seawater-soaked wood."

Indiscriminate burning of debris observed in Minami-sanriku, Miyagi, July 9, 2011

Soil testing for dangerous chemicals have begun in certain areas, including Sendai city in Miyagi prefecture, and has so far revealed oil contamination and persistent organic pollutants (POPs), and low levels of other chemicals such as arsenic, PCBs or heavy metals. Bird and Grossman note: "Many of these compounds are respiratory hazards, neurotoxicants, and/or carcinogens. Many are potentially acutely toxic. Some are also environmentally persistent, which raises potential issues of long-term contamination, particularly to local soil and water." Another pressing concern for farmers in the tsunami-hit areas is the salt content in their soil, and if it can be washed out from the fields quickly enough to allow farming to resume.[28]

Consumers in Japan and other countries have held Japanese agricultural products in high esteem thanks to the diligence of farmers, fishermen and food producers. It is impossible to estimate the real effects of this crisis and how Japan's food supply system will recover. The damage in the coastal Tohoku region to the fisheries sector is overwhelming, with over 21,500 boats and 319 harbours damaged or destroyed. For the agricultural sector, over 33,000 farms, facilities, sewerage facilities, drains, pumps etc. have been damaged or destroyed. The total damage to agriculture, forestry and fisheries by July 5, 2011 was estimated to be 2,115 billion yen, a staggering amount.[29]

Conclusions

We can only express our deepest sympathies to everyone involved in the rebuilding of the Tohoku region. It is important to note that vegetables or other foods that are being measured outside of the most contaminated region in Fukushima prefecture show very low levels or do not show any detectable levels of radioactive substances three to four months after the nuclear disaster at Fukushima Daiichi Nuclear Plant. In most parts of the Tohoku region in northeastern Japan, there is zero or almost no detectable nuclear contamination. In the rest of Japan, consumers can rest assured that there is no radioactive material on their dinner tables.

Based on the official data as published by Japan's Ministry of Health, it emerges that three to four months after March 11, with the exception of food from certain areas in Fukushima prefecture (and possibly tea that was grown outdoors on tea shrubs since March), Japan's farmed food supply and its products can be generally regarded as safe. Japan has 1.9 million farms producing food from Hokkaido in the north to Okinawa in the south, and will by all accounts continue to make every effort to feed its population with domestic vegetables, fruit, grains, and so on.

Thinking ahead, the issue of soil contamination and accumulation needs to be addressed and carefully monitored, as it will affect rice production, especially in parts of Fukushima prefecture. Pollution problems such as asbestos, dioxin and PCB, due to post-March 11 fires and indiscriminate burning of debris and garbage, will add to the health risk. There are also worries about small or large radioactive hotspots in areas with higher levels of contamination from the Fukushima Daiichi Nuclear Plant. More precise maps of the contamination must be prepared by reliable methods.

Much needs to be done to limit long-term contamination and protect consumers in addition to generally help regain the trust and confidence in Japanese food. Producers also require support. Farmers, fishermen and food producers need to be compensated and areas devastated by earthquake, tsunami and meltdown need to be restored with due attention to radiation risk. The stakes for Japan in doing so are high.

This is an updated and expanded version of a paper written for Consumers Union of Japan.

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Notes

[1] FAO: Fact Sheet on Codex Guideline Levels for Radionuclides in Foods Contaminated Following a Nuclear or Radiological Emergency-Prepared by Codex Secretariat (May 2, 2011), link.

[2] FSCJ: Graphical Explanation of "Emergency Report on Radioactive Nuclides in Food" (accessed July 8, 2011)

[3] FSCJ: Radioactive Contamination of Food in Japan (Accessed July 8, 2011), link.

[4] See for example the table of Radiation exposure limits for food, based on MAFF data, in The Japan Times (June 26, 2011), link.

[5] MHLW (March 22, 2011), link.

[6] MHLW (March 19, 2011), link.

[7] MHLW (March 22, 2011), link.

[8] MHLW (March 20, 2011), link.

[9] MHLW (March 21, 2011), link.

[10] MHLW (March 23, 2011), link.

[11] The Japan Times: Irradiated food poses moral dilemmas (June 26, 2011), link.

[12] Daichi wo Mamoru Kai: いま、私たちができること。大地を守る会の震災復興支援 (March 23, 2011, in Japanese, accessed July 8, 2011), link.

[13] The Japan Times: State to buy all radioactive beef (July 22, 2011), link.

[14] NHK World: Radiation detected in beef from Fukushima (July 9, 2011), link.

[15] For a detailed analysis of media reports about the beef issue, please see Asia-Pacific Journal Feature: Japan's Irradiated Beef Scandal (July 25, 2011).

[16] MHLW (June 24, 2011), link.

[17] MHLW (June 25, 2011), link.

[18] MAFF (July 5, 2011), link.

[19] MAFF (June 23, 2011), link.

[20] MHLW (June 29, 2011), link.

[21] MHLW (July 1, 2011), link.

[22] Shizuoka Prefecture: Test Results for Radioactivity on Tea Produced in Shizuoka Prefecture (June 30, 2011), link.

[23] Bloomberg: Food safety fears grow in Japan on skepticism at radiation testing regime (June 16, 2011), link.

[24] ATMC.jp (In Japanese, accessed July 8, 2011. This website has an option of translating the pages into various languages.), link.

[25] CRIIRAD: Note No11-47 E C3 (Accessed July 8, 2011), link.

[26] CRIIRAD: Consequences of the Fukushima Daiichi Accident in Japan: A substantial and long-lasting contamination (July 7, 2011). The results of the soil sampling must be further analyzed to avoid farming in areas with high levels of radioactive contamination.

[27] Bird WA, Grossman E, 2011 Chemical Aftermath: Contamination and Cleanup Following the Tohoku Earthquake and Tsunami. Environ Health Perspect 119(7). (July 1, 2011), link.

[28] Agweek: Japanese farmers affected by tsunami hopeful for swift recovery (April 5, 2011), link.

[29] MAFF: The Damages caused by the Great East Japan Earthquake and Actions taken by Ministry of Agriculture, Forestry and Fisheries (July 6, 2011), link.