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Committee on Radiation Protection and Public Health

Framework for the Post-Accident Management of Contaminated Food

For any queries regarding this document please contact Dr.Ted Lazo (edward.lazo@oecd.org)

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Radiological Protection

Framework for the Post-Accident Management of Contaminated Food

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NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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The mission of the NEA is:

– to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
– to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include the safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information.

The NEA Data Bank provides nuclear data and computer programme services for participating countries. In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

FORWARD

At its March 2012 meeting, the Committee on Radiation Protection and Public Health (CRPPH) agreed that many important questions related to radiological criteria for commodities and food following the 2011 Fukushima accident in Japan needed to be addressed. The CRPPH felt that this subject was an area which could be explored further, and it assigned the task to its Expert Group on the Radiological Protection Aspects of the Fukushima Accident (EGRPF). The EGRPF held its 2nd annual meeting in June 2012, immediately following the March 2012 CRPPH meeting, where its participating members subsequently approved the establishment of an additional Sub-Group called the EGRPF Sub-Group on Trade in Commodities and Food. The Sub-Group's purpose was to develop a framework paper which could subsequently be passed to the IAEA and the FAO as input to their development of new safety standards on trade in post-accident contaminated food. In October 2012, the first meeting of the newly established Sub-Group was held, and over the course of 2013, the EGRPF Sub-Group developed preliminary recommendations for a framework for the development of trade criteria for food, consumer products and commodities following a nuclear or radiological emergency. Their recommendation was submitted to the annual CRPPH meeting in May 2013 where it was then discussed by member countries. Rather than developing a set of criteria, the Sub-Group instead sought to develop a framework that could guide approaches to post-accident food safety, radiation protection, and trade into the future. This report expands upon the foundation that the Sub-Group built.

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EXECUTIVE SUMMARY

Prior to the accident at the Japanese Fukushima Daiichi nuclear facilities in 2011, international standards related to radiation protection had been well-established. International bodies have worked to lay a foundation intended to guide national decisions in the process of authorising items from post-accident affected areas within a country for consumption, to be released to national and international markets, and for authorising the importation of items from post-accident affected areas in another country. Different activity concentration values and trade related protection matters, the ways in which they are derived or developed, and the circumstances under which they are intended to be applied, however, are not always clearly understood.

The NEA has, by consequence, developed a framework for the post-accident management of food in an attempt to rationalise the radiological criteria that will be developed to protect those eating food coming from areas affected by radiological contamination, brought on by a radiological or nuclear accident or a malicious act. The framework simultaneously identifies strengths in the existing regimes for food safety and international trade while providing for practical flexibility for countries facing nuclear or radiological emergencies. The central themes of the framework are; that accidents are rare and distinct; the accident country will quickly stop trade until the situation is under control; the accident country will develop criteria based on the protection of the most exposed group; and accident-specific national criteria should drive international, accident-related criteria.

The outlines of the NEA framework, rooted firmly in historical experience with radiation protection, are here introduced, examined through the lens of the most recent accident, and finally situated into existing international trade law, understanding, and practice. By examining the overlap, strengths, and gaps in trade and food safety cooperation with this report, the NEA hoped to further develop its framework by understanding the governance challenges presented by a future nuclear accident in an increasingly connected world. Other future studies on the subject must address that social and political factors, which are often motivated by consumers' views, may lead to prolonged trade restrictions against a nation affected by a nuclear accident, and that within the existing trade and food safety framework, there is difficulty in synchronizing the actions of exporters, in all food safety related situations, with the expectations and demands of importers concerning food quality and safety. The framework has been endorsed by the Committee for Radiation Protection and Public Health (CRPPH) and will be passed to the IAEA and the FAO as input to their development of new safety standards on trade in post-accident contaminated food.

SECTION I: INTRODUCTION

PART I: THE NEA FRAMEWORK FOR THE MANAGEMENT OF FOOD AND WATER FOLLOWING A NUCLEAR OR RADIOLOGICAL EMERGENCY

The NEA framework for the post-accident management of food is an attempt to rationalise the radiological criteria that will be developed to protect those eating food coming from areas affected by radiological contamination, brought on by a radiological or nuclear accident or a malicious act. Those that could be affected include any individuals living in the affected areas, those in the accident country but not living in affected areas, and individuals in other countries where food from the affected areas may be imported. The NEA framework provides for a structured approach to developing criteria to address the radiological protection of all those potentially consuming goods from affected areas.

General Considerations

The new recommendations of the International Commission on Radiological Protection (ICRP), as presented in ICRP Publication 103, focus on the optimisation of protection in order to appropriately address the prevailing circumstances in an accident scenario. In the context of a framework intended to protect people from contaminated food in an emergency exposure situation or in a post-accident existing exposure situation, all protection decisions taken by policy makers must be guided and ultimately driven by the circumstances on the ground, circumstances which include, most notably, the types of food crops affected, the distribution of their levels of contamination, the types of radionuclides involved, etc.

The occurrence of large-scale nuclear or radiological accidents, or malicious acts involving radioactive materials, is rare. Although the rare occurrence of such a situation may result in the contamination of a relatively large geographic area (e.g. the area touched by fallout from the Chernobyl accident), the number of food products affected is most likely to be limited. Additionally, it is likely that the number of food products produced in any affected area, and which have been routinely exported, will constitute a small fraction of the total number of goods normally produced in the affected area.

Key Recommendations

Governments have the responsibility to develop national criteria for the management of food from affected areas given these considerations. The EGRPF Sub-Group initially envisioned and developed a framework approach in which criteria for trade in contaminated food and goods could be defined, which could cover both those for local consumption in the affected areas and which could be extended through to the importation of food by other countries. The central themes of the framework are; that accidents requiring trade criteria to be established will be rare and distinct; the accident country can be expected to quickly intervene to prevent trade until the situation is under firm control and the contamination is fully characterised; the accident country should develop criteria for the protection of its own population in contaminated areas, which could then be extended to protection of foods and goods consumed elsewhere in the accident country, and for food and goods leaving the country; lastly, these accident-specific national criteria must drive international, accident-related criteria. In more detail, the NEA suggests that the following framework elements:

1. <u>Emergency Exposure Situations</u>

Emergency exposure situations are generally events whose evolution and consequences are initially extremely uncertain, and their uncertainty can prevail for some time. Such situations may evolve rapidly, in minutes or hours, or over a long period of days or weeks. In general, in such uncertain and potentially rapidly changing circumstances, radiological protection decisions must be weighted heavily to the precautionary side. As such, with regard to food consumption, the implementation of precautionary protective actions will often include some level of food restriction in a pre-determined area based on conservative models and pre-determined food-restriction levels.

It is the responsibility of governments to determine and establish restriction levels for food consumption within the country, food exported from the country, and in the case of an accident in another country, for food imported from an accident country.

2. <u>Urgent Food Protective Actions</u>

The accident situation will evolve and hopefully be brought quickly under control. The radiological characteristics of the situation will need to be identified, and as far as food is concerned, measurements will need to be made in production fields. For backyard gardens, instrumentation and procedures will need to be made available, and training will be needed for operators (e.g. local pharmacists).

3. <u>Addressing Prevailing Circumstances</u>

The measurements and preparation processes will take time, during which a more precise picture of contaminated food can be concurrently developed. The decisions of and arrangements made by policy makers can be expected to consume additional time. During any interval period, with a growing and deeper understanding of what has been contaminated and to what range of levels, pre-determined food restriction levels could serve as a starting point from which new levels can be adapted to more precisely reflect the prevailing circumstances.

4. Protecting Those Most at Risk

The focus of protective measures for affected food should be the population that is most at risk. In general, this group will be those living in the affected areas and who consume local foods. Unless the accident occurs in an area where replacement food is not available, it should be possible to use a dose target of 1 mSv in a year for consumption of affected foods in the affected areas.

5. Consistency of Food Protection Criteria

The movement of commercial crops from the affected areas will not resume until allowed levels have been established, and the mechanisms for performing certification measurements have been put in place.

It is likely that, for social, political, legal, and even ethical reasons, governments will use the same numerical criteria for the consumption of food by the most exposed group (normally those living in the affected area) for those living in parts of the country not affected by contamination from the accident, and for export of food to other countries. For this reason, and to promote consistency, the Codex Alimentarius values should be used as an upper bound for the selection of national food criteria to protect those most at risk.

6. Evolution of Criteria

Food criteria should be situation-specific to address the accident that has occurred. They should thus be developed at the time of an accident, based on generic levels needed for reflex actions. Criteria will most likely evolve as the prevailing circumstances change.

PART II: DEVELOPMENT OF NEA FRAMEWORK

The structure of the NEA framework, as initially developed by the EGRPF Sub-Group on Trade in Commodities and Food, is balanced and robust, allowing for several critical extensions of the framework to be made. The framework simultaneously identifies strengths in the existing regimes for food safety while providing for practical flexibility for countries facing nuclear or radiological emergencies. International organizations can provide invaluable resources to countries facing an emergency situation, but decisions for authorising items from post-accident affected areas to be released to national and international markets and for authorising the importation of the same items must remain the responsibility of national governments. National governments have diverse domestic priorities and in all likelihood possess the most complete set of information related to the circumstances at hand.

At the same time, the international community will not start from scratch in the topic of food safety and trade following an accident, and several international agreements on food safety criteria provide fundamental guidance. The Codex recommendations are of central importance, and despite occasional disagreement related to these recommendations, they are often the basis for national legislation.

This framework has added value in that it does not overextend its recommendations so far as to make them unrealistic or specific to one imaginable future scenario. Each accident will have unforeseen characteristics that will require a specifically tailored response. As one would anticipate, the management of food consumption and trade can be different in the early uncertain period of an accident in contrast to when contamination levels are known and control measurement mechanisms are in place.

Lastly, the framework provides a convincing case to further harmonize the safety measures implemented at the domestic level and for those implemented at international borders. This issue will be taken up below. A guiding conclusion from the Sub-Group recommendations, which is now a bedrock of the NEA framework, is that a single set of criteria (levels in Bq/kg or Bq/L) based on the long-term protection of the "most exposed group" (e.g. those living in the contaminated area), should be used to manage all consumption and trade in food products. As the following report details, differences in criteria could result in reputational consequences and increased economic costs. This harmonization of approaches to domestically traded and internationally traded food at levels (Bq/kg or Bq/L) would result in internal exposures (mSv/a) acceptable for populations living for the long-term in affected areas and result in lower levels of exposure for populations living outside the directly affected areas.

Background

The past three decades have witnessed a dramatic transformation in international trade patterns in agricultural goods. Developing concurrently and continuously with these patterns have been increasingly detailed and complex regulatory structures at the international and national level to meet rising demand for food safety. Because food safety is essential for human health and because it is considered a "luxury" good, whose demand rises as income levels rise, the growth in emerging markets such as China and Brazil will most likely be accompanied "by increased demand for more stringent SPS standards" worldwide.[1] The heightened concern over radionuclides in food following the 2011 Japanese Fukushima nuclear accident, an accident which occurred on the heels of other food safety experiences of the last decade, including the 2008 Chinese melamine incident and several *E. coli* and salmonella scares, demonstrated how this demand has only become more prevalent.

In the long history of nuclear development worldwide, only two accidents have escalated to a level requiring national and international attention, cooperation, and intervention to prevent radiation exposure to large groups of people. Today, safety prevention measures are continuously scrutinized and updated while contingency plans for unlikely accidents are reexamined and modified. To that extent, the most recent accident in Japan presented new challenges that warrant a revisit to previous thinking while also demonstrating why the need to develop more thorough safety approaches for any future nuclear or radiological accident will continue unabated. The rapidly evolving characteristics of the global economy impart an additional sense of urgency as the likelihood that a foodborne illness or food safety scare of the sort will affect larger groups of people in scattered places will only continue to grow as an ever increasing amount of services, investment, people, information, and goods transcend national boundaries. At no other time has it

[1] Athukorala, P. and S. Jayasuriya (2003), "Food Safety Issues, Trade and WTO Rules A developing country perspective" *World Economy*, 26 pp. 1395–1416. P. 2.

been as imperative to explore how international trade and food safety issues following an accident are related and to formulate a coherent framework for the management of food and water affected by a nuclear or radiological accident.

The dynamics of international trade and of the domestic distribution processes of food are integral to developing strategies for radiation protection. An accident could potentially affect those living in the territories where the accident occurs, the unaffected territories in the accident country(ies), and those living in other countries importing food or water from the affected country(ies). Accidents will most-likely affect only a discrete and limited number of export food products from any affected area, but the possibility for contact with these food products, and with radiation levels that must be considered, shifts dramatically depending on existing health and disease conditions in certain areas, the existing environmental climate, and patters of ingestion habits for individuals. Worldwide, the patterns of trade in agricultural goods can best be characterized by regional or bilateral clusters, given the constraints of distance and time. Most often, an individual country is the top producer and exporter for a food product within a specific region, and lower producing countries nearby are relatively more dependent on that top producer for imports of that food product. The level of integration or “connectedness” on the international scale between countries can vary. The question that inevitably must be addressed is whether a framework can be developed that is both broad enough to factor in these concerns while also providing robust safety recommendations to any country grappling with an accident in the future.

Compounding matters for any framework development is that any future accident will be unanticipated with unforeseen challenges. To attempt to predict the characteristics of a future accident is virtually impossible. The type, magnitude, and effects of an accident could vary almost infinitely. A fixed set of scientific parameters and detailed food safety implementation measures is unrealistic. Even if, for example, a country affected by an accident has the analytical equipment to perform pre-approved food safety inspections, they may not operate at the planned level in the emergency situation. Analytical equipment may be damaged, particularly if the accident is precipitated by natural causes, as was the case for the Japanese following the earthquake that eventually led to the damage at the Fukushima Daiichi Nuclear Power Plant. Inspectors may lack complete knowledge of the analytical devices as the devices are likely to never have been used. Further, officials may not completely understand how to appropriately collect samples. Private laboratories could deny being sent contaminated samples in the moment of an actual situation, and damage to key components of the national infrastructure or transportation could prohibit the necessary sample collection. By consequence, all radiation protection criteria developed in advance, by nuclear producing states in coordination with the relevant international organizations (IAEA, NEA, ICRP), despite the fit with previous understandings and research, can therefore be expected to shift with time as the accident situation evolves. In addition, in all likelihood the authorities with the most immediate responsibility in the aftermath of an accident will possess the most complete set of information and an understanding of national priorities. For that, public protection and export criteria will always remain a matter of national choice.

At the outset, a very clear analytical distinction must be made between the period immediately following an accident (emergency-exposure situation) and the period that subsequently follows when the facts on the ground become more visible to regulators and when the safety risk can be most accurately be evaluated (existing-exposure situation). Although several broad definitions exist, when the explicit shift between these two periods takes place remains unclear. The IAEA and NEA continue to address the subject. The most recent Japanese experience demonstrated that various areas of land can be cleared as operating in existing-exposure situations while other adjacent and nearby areas can remain under the inspection processes of an emergency-exposure situation for longer. In general, a situation can be characterised as being at the end of the emergency-exposure situation when capabilities are put in place to monitor foods, and when the extent and concentrations of contamination are well understood. As the ICRP has stipulated, however, the end of an emergency-exposure situation cannot be specifically identified based on pre-defined criteria. Rather, the end is most explicitly marked by a decision taken by a national government when it feels it has sufficient control. At the same time, the end of an emergency-exposure situation is likely accompanied by the following characterises: all releases have been stopped and control of the damaged installation is regained such that no further releases are expected; an understanding of the contamination situation has been achieved; and monitoring capabilities are established to support bringing consumer products and commodities to market for sale and trade.

In any case, immediately following an accident, the degree, scope, and stretch of the contamination is uncertain, both in terms of geographic reach and overall contamination effect on agricultural goods and production possibilities. Food initially destined for domestic consumption or for international markets through trade should thereby be completely restricted during this emergency situation phase to prevent any worldwide consumption that cannot be accounted for. Restrictions, which should remain until no further releases are expected, could range from removing from distribution those foods deemed to be of radiological significance (e.g. leafy vegetables, milk, etc.), to minimal control of food deemed to be of less radiological significance (e.g. food stored in warehouses during releases or food that contributes little the exposure to those consuming it, such as food consumed in very small quantities; etc.). Food already in transport prior to the event does not need to be restricted. The process of later granting permission to eat and trade the food emanating from affected areas should be granted by the relevant authority only after all related measurement and certification processes have been firmly established with a sustainable infrastructure. Understandably, the process of putting into place the necessary infrastructure may pose vexing challenges if a certain level of existing infrastructure was damaged by an accident.

Although to correctly predict the characteristics of a future accident is virtually impossible, as detailed above, previous established national criteria and restrictions should serve as the detailed foundation and launching pad from which aggressive emergency action can be taken. While the emergency-exposure situation at hand is being brought under control, characterization of the situation is carried out, and measurement processes are being formulated and implemented, these national criteria should be adapted from pre-planned criteria to address “situation-specific” circumstances. As time passes, increasing knowledge and certainty with regard to the emergency-exposure situation allows for effective organisation of measurement and management approaches for trade. Decreasing contamination levels as a result of decontamination actions, radioactive decay, and environmental processes over the long-term reduces the overall risk to human health. The process of developing national criteria and restrictions in advance will present ideal opportunities to assess the particular hurdles that any single member state may face in the wake of an accident, thereby allowing a more rapid and well-calibrated response should an accident ever occur.

The relatively more complex nature of an emergency-exposure situation allows for less concrete proposals, but existing-exposure situations allow for more thorough and detailed planning in advance. As the situation evolves, there should be periodic review of any criteria adopted in order to assure that the criteria continue to meet stated national policy goals. In the long-run, as the circumstances progress more concretely from an emergency-exposure situation to an existing-exposure situation and the national authorities have in possession the necessary grip of the facts, national criteria should gradually be built upon one central focus of protecting the most exposed group in the long-run (those individuals living in the affected area) at a level of 1 mSv/a. For purposes of administrative practicality and capacity, it is highly likely that national governments will already apply the same criteria for food and water in the affected area, in national areas not affected by the accident, and for export. It is important to note here that it is not inconceivable that an individual could be exposed to more than one traded item coming from the affected area. By consequence, operational criteria for those items (e.g. in Bq/kg, Bq/L, etc.) should be adjusted to assure that no individual could possibly be exposed above the dose rate criteria (e.g. in mSv/a) on which the operational criteria were calculated.

The importance in highlighting the focus on protecting the most exposed group is clear. To see why, consider the repercussions that any national government would face from a domestic and international audience in the event that its radiation protection specialists and authorities attempted to justify different protection measures for different groups of the national population. Second, it is logical to conclude that if national criteria measures are built to protect the most exposed group then those living in the unaffected territories in the accident country(ies) and those living in other countries importing food or water from the affected country(ies) would receive a much less significant dose rate. Intervention levels in the affected regions are calculated with the assumption that the population receives 100% of its food from the affected area. Those not living in the affected area are likely to consume a “food basket” that is at maximum 10% contaminated by food from the affected region, even with the most generous of assumptions. Lastly, from a more economic and international trade perspective, differing intervention levels are likely to send mixed signals to consumers worldwide who are in all probability already sceptical of food coming from an affected area. The less information a consumer must interpret to understand the risks, the greater the chance that the asymmetry in understanding is reduced.

The NEA framework, while unique, recognizes the value and importance of international agreements on national criteria, particular those outlined by the Codex Alimentarius Commission, and believes they cannot be understated given their depth, applicability, and scientific foundation. As is true for most issues at the international level, there is not always international agreement on all Codex recommendations, but they undoubtedly can serve as a basis for national legislation, particularly for those states that have not previously developed national criteria. Given that the internationally agreed to guideline levels listed in the Codex General Standard for Contaminants and Toxins in Food and Feed provides radiological criteria for imported food is based on 1 mSv/a, this limit is best considered as the upper-bound for national criteria.

The outlines of the NEA framework introduced above are rooted firmly in historical experience with radiation protection, and, as will become increasingly clear, can be situated perfectly into existing international trade law, understanding, and practice.

SECTION II: STUDIES IN TECHNICAL ASPECTS

PART III: ANALYSIS OF THE NEA FRAMEWORK IN THE ACTUAL SITUATION: CASE STUDY IN JAPAN

To first situate the NEA framework within existing experience, it is imperative to once more review the Japanese experience. One year after the Fukushima accident, the Japanese government, based on the principal of ALARA (as low as reasonably achievable) for food safety, adopted new food safety limits (*1), which were consistent with the Codex General Standard for Contaminants and Toxins in Food and Feed and the criteria that the EGRPF Sub-Group recommended. To this day, a large amount of testing continues to be carried out with these limits, and this testing has revealed that the percentage of foods exceeding the limits remains extremely low, even for those foods grown and produced in the radiological contaminated areas (*2). Most tests in Japan are performed prior to shipment, and foods that exceed the established criteria are restricted from entering into agriculture markets. Foods that are eventually distributed to domestic and international markets are also monitored by the Japanese government, and, to date, the results of that monitoring reveal a high degree of success with regard to the Japanese safe food production system and the government's domestic inspections measures. The successful implementation of these criteria and in providing that individuals do not receive a dose exceeding 1 mSv in a year has been firmly established by external objective scientific research (*3).

Provided the strong existing scientific evidence, it is not a stretch to suggest that foods exported from Japan can be expected to be below the Codex recommendations for importation. Food imported from Japan will give far lower exposures to individuals than would be received from other single internal exposures, which are normally caused by naturally occurring radionuclides. By consequence, any measure to completely restrict imports from Japan, in the form of an import ban for example, is difficult to justify. The existing body of scientific evidence also largely discredits any recourse to the "Precautionary principle" within the World Trade Organization (WTO) SPS Agreement, of which more will be said in the following section.

※ 1.Criteria was introduced by the Japanese government based on the principal of ALARA for food safety. Immediately following the accident, fallout from pre-harvested crops was seen as the main contamination pathway from agricultural products. In the longer-term, however, when the source of radiological releases were under control, it became clear to regulators that contamination levels would be smaller than was initially thought following the accident. Monitoring results showed a consistently decreasing level of contamination in the majority of Japanese foods. Figures 1A to 1D reveal the frequency distribution for both fallout periods and the uptake period for each relevant agricultural product. These results show that most foods had achieved the established 100 Bq/kg limits set by the Japanese in the first year of its implementation, thereby suggesting that the criteria were appropriate.

FIGURE 1: Monitoring Results in Japan before and after the start of implementation of limits (Provided to 72nd CRPPH Annual Meeting by the Japanese Ministry of Agriculture, Forestry and Fisheries, Analysis were carrying out by local governments based on Food safety act and collected by the Japanese Ministry of Health, Labour and Welfare)

FIGURE 1A: Monitoring Results of Vegetables

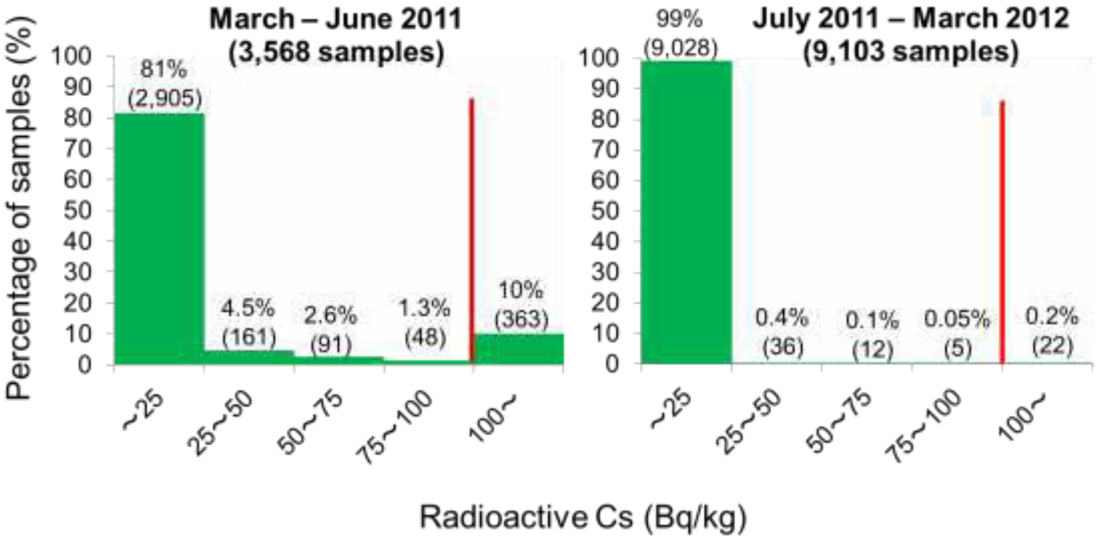


FIGURE 1B: Monitoring Results of Wheat

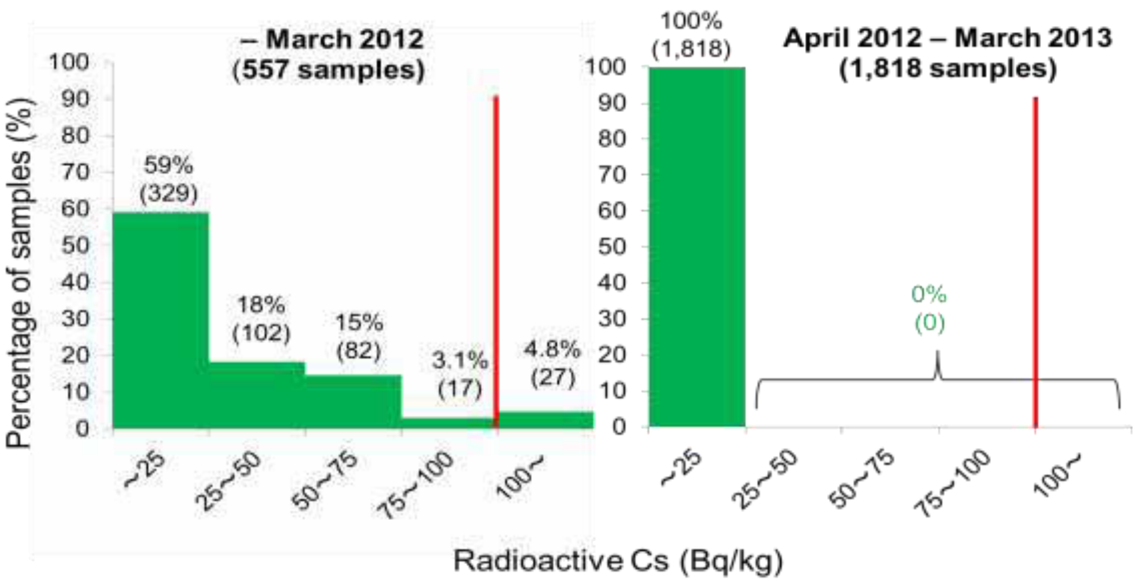


FIGURE 1C: Monitoring Results of Fruits

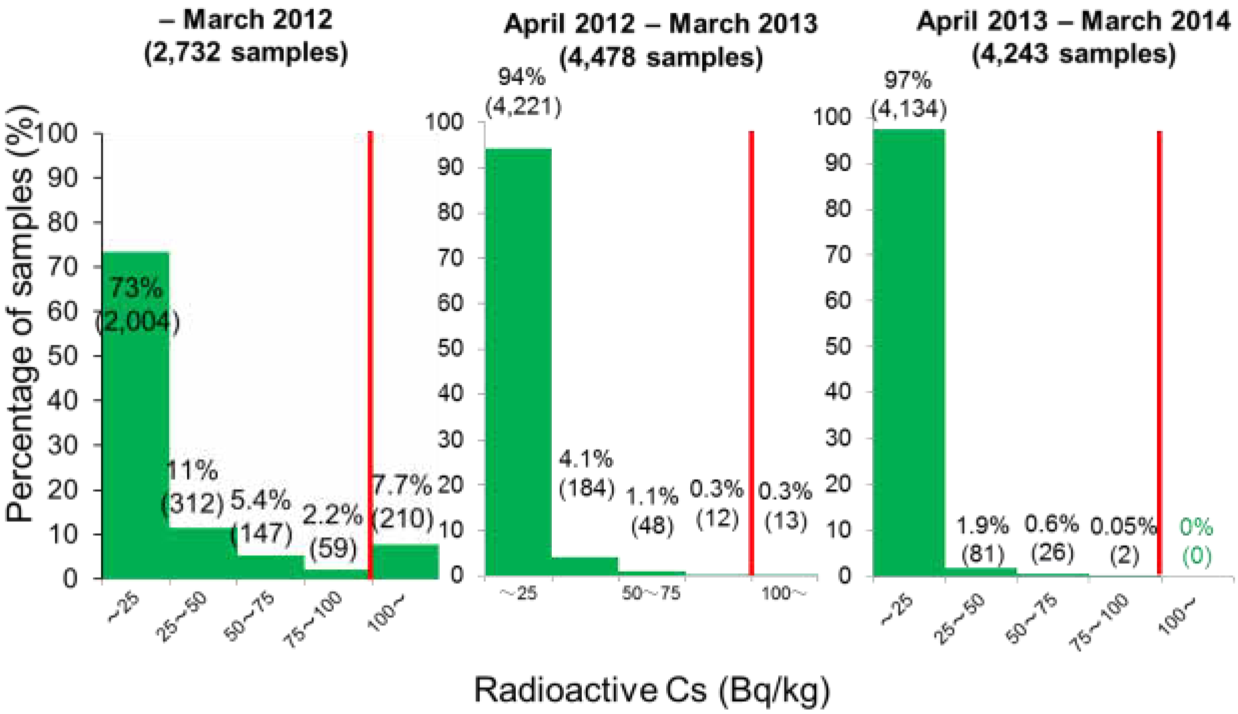
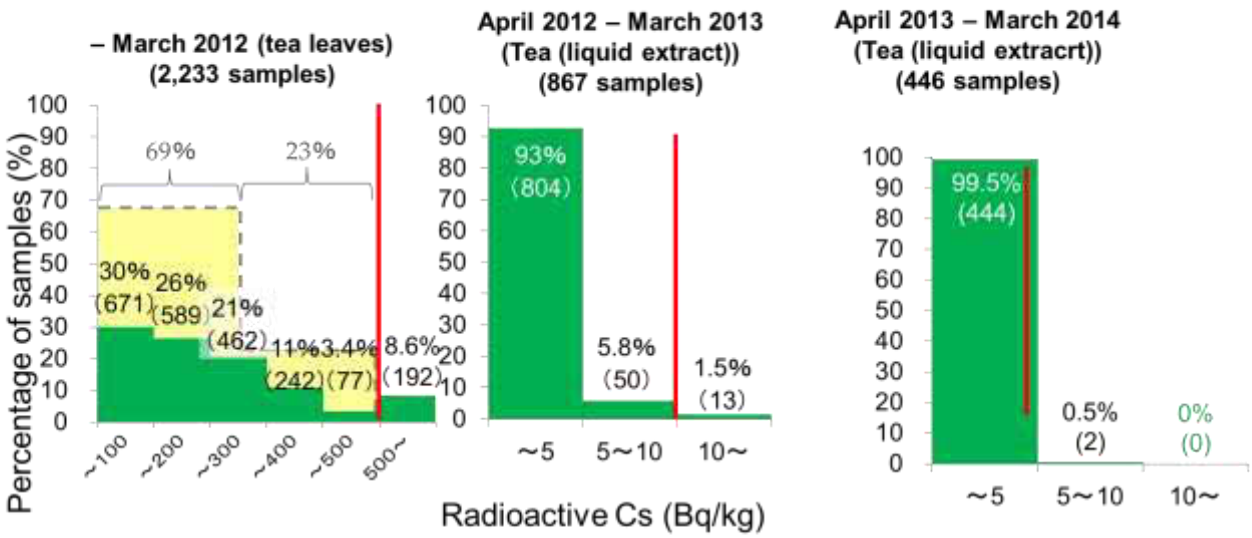


FIGURE 1D: Monitoring Results of Tea



Note: The regulation limit for tea was 500 Bq/kg which was applied to tea leaves until March 2012. The limit has been revised to 10 Bq/kg which is applied to tea as liquid extract since April 2012.

※ 2. In a monitoring inspection conducted in Japan between April 2013 and March 2014, not a single case was reported where levels of radiation in wheat, vegetables, fruits, tea, dairy, meat or eggs exceeded the established criteria. Values exceeding the criteria were found in a limited sample of foods, predominantly in legumes (0.4%, 21 in 5136 inspected cases; 98.4% samples below 50Bq/kg or under detection limits) and rice (0.00003%, 28 in 10,990,000 inspected cases; 99.9% samples under 50Bq/kg or under detectable limit) (Table 1).

In the case of seafood (seawater and freshwater products), monitoring has been focused on species that had previously recorded more than 50 Bq/kg in the emergency situation. Even with this strong positive bias however, the excess ratio of seafood in Japan, excluding the Fukushima prefecture, is on the order 0.1% as of July, 2014. In most cases, the seafood registers below detection limits. It was also discovered that the excess ratio from the Fukushima prefecture was very small, on the order of 0.6% as of July, 2014, while also showing a decreasing trend. Seafood from Fukushima is currently not shipped because coastal fishing and trawl fishing off Fukushima have been suspended, notwithstanding a small degree of trial fishing.

※ 3. The Japanese National Institute of Health Sciences has continuously conducted radioactive caesium measurements in distributed foods (via the “market basket method”). Samples purchased from fifteen nationwide regions, including three Fukushima areas (Hamadori area, Nakadori area and Aizu area) conducted between September-October 2013, were analysed to estimate the radiation dose received from radioactive caesium in foods each year. It was then confirmed that the annual radiation dose received from radioactive caesium in food was approximately 0.0008 - 0.0027 mSv per year for an individual, a measure which is considerably smaller than the 1% of the international common criteria for the additional radiation dose (1 mSv per year) received from food intake.[2]

Scientists at the National Institute of Public Health have also continuously conducted radioactive caesium measurements in meals prepared at home (via the “duplicated method”). Samples were collected from ten nationwide regions in March 2013, including three Fukushima areas (Hamadori, Nakadori and Aizu) involving the two main meals consumed by 82 people (45 adult and 37 infants), in order to estimate the radiation dose received from radioactive caesium in food each year. In this case, the annual radiation dose received from radioactive caesium in food was estimated at 0.0001 - 0.0022 mSv per year in infants and 0.0002 - 0.0017 mSv per year in adults.[3] Both estimates are small and less than 1% of the recommended 1 mSv per year.

These investigations, with the use of both methods, have been continuously performed since the time of the accident in 2011 with support of Ministry of Health Labour and Welfare in Japan.[4] Independent inspectors, including several consumers associations and various media

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[2] "Survey Results of Radiation Dose Received from Radioactive Cesium in Food (Octovber 9, 2013 Survey Results); 食品中の放射性セシウムから受ける放射線量の調査結果（平成25年９・10月調査分." *Japanese Ministry for Health, Labour, and Welfare*. N.p., n.d. Web. 3 Nov. 2014. <http://www.mhlw.go.jp/stf/houdou/0000050813.html>.

[3] "Results from Food Radiation Dose Survey (March 2013 Kagezen Investigation); 食品から受ける放射線量の調査結果（平成25年３月陰膳調査分." *Japanese Ministry for Health, Labour, and Welfare*. N.p., n.d. Web. 3 Nov. 2014. <http://www.mhlw.go.jp/stf/houdou/0000028844.html>.

[4] "Information Related to the Great Japanese Earthquake; 東日本大震災関連情報". N.p., n.d. Web. 3 Nov. 2014. <http://www.mhlw.go.jp/shinsai_jouhou/shokuhin.html>.

outlets, have additionally carried investigations via the duplicate portion method.[5] In all those investigations, similar results had been observed.

Many local governments followed the national government by performing their own duplicated method analysis for school lunches with the goal of bringing peace of mind to the Japanese citizens. These surveys were initially advocated by Japanese researchers at the University of Tokyo. According to the education board of the Fukushima prefecture, in 2013 more than 2,480 school lunches were analysed and radiological caesium was detected in a total of 6 samples (Maximum 1.28Bq/kg for Cs-134 and Cs-137).

TABLE 1 – FY 2013 Japanese Monitoring Results (Apr. 2013 – Mar. 2014) (provided to 72nd CRPPH Annual Meeting by the Japanese Ministry of Agriculture, Forestry and Fisheries; Analysis carrying out by local governments, based on Food Safety Act, assembled by Japanese Ministry of Health, Labour and Welfare)

	Sample No.	Sample >limit			
		No.	(%)	2012FY (%)	2011FY (%)
Rice	10,990,000	28	0.0003	0.0008	2.2
Wheat	592	0	0	0	4.8
Beans	5,163	21	0.4	1.1	2.3
Vegetables	19,657	0	0	0.03	3.0
Fruits	4,243	0	0	0.3	7.7
Tea	446	0	0	1.5	8.6
Other agricultural products	1,618	0	0	0.5	3.2
Milk	2,040	0	0	0	0.4
Meat and Eggs	194,945	0	0	0.003	1.3

Note: Regulation limits:
General food: 500 Bq/kg (- Mar 2012), 100 Bq/kg (Apr.2014 -)
Tea: 500 Bq/kg (as tea leaves, - Mar 2012), 10 Bq/kg (as Tea liquid, Apr.2014 -)
Milk: 200 Bq/kg (- Mar 2012), 50 Bq/kg (Apr.2014 -)

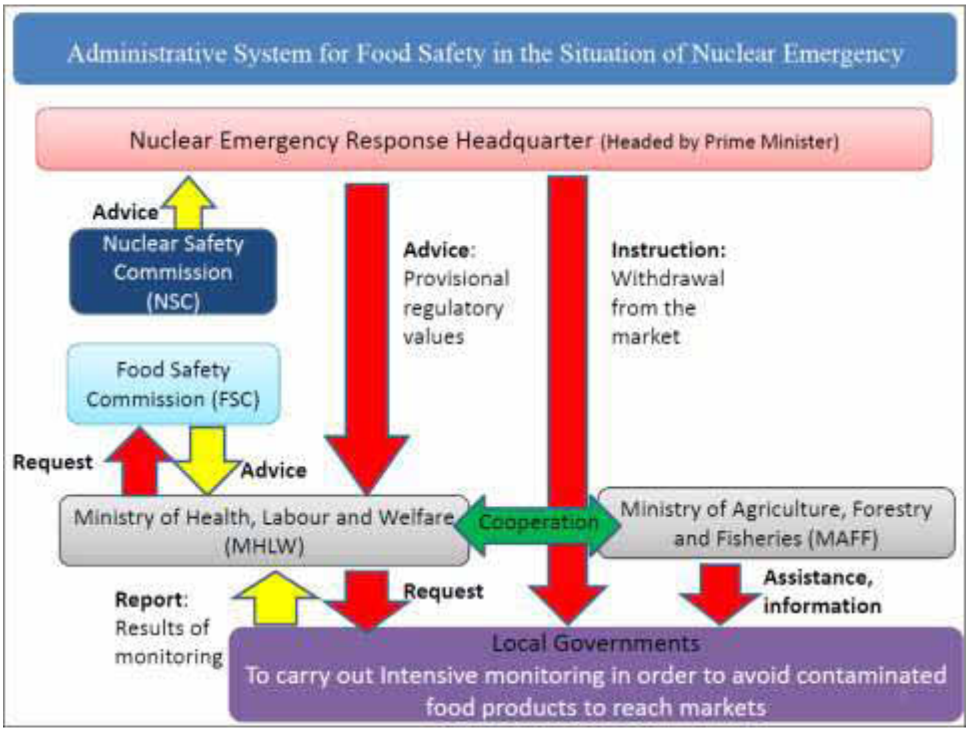
[5] See for example; "Efforts for the Great East Japan Earthquake; 東日本大震災に関する取り組み." *Coop Fukushima*. N.p., n.d. Web. 3 Nov. 2014. <http://www.fukushima.coop/300_benri/380_sinsai_torikumi.html>.

PART IV: THE TIME FRAME OF COUNTER-MEASURES FOR RADIONUCLIDE CONTAMINATION IN FOODS FOLLOWING THE FUKUSHIMA ACCIDENT IN JAPAN

The time frame of events in 2011 provides additional credence to the outline of the NEA framework. Immediately after the accident on March 11, 2011 at the Japanese Fukushima Daiichi Nuclear Power Plant, which was operated by the Tokyo Electric Power Company, the Japanese Government began to take actions to ensure sufficient supplies of safe food and feed were provided to the Japanese population. On March 17th, the Ministry of Health, Labour, and Welfare (MHLW), in consultation with the Nuclear Emergency Response Headquarters, put into action the *Indices for Food and Beverage Intake Restriction.* This index was a series of provisional regulations that had been established by the Nuclear Safety Commission prior to the earthquake to guide provisional regulation values of the Food Sanitation Act. In accordance with Article 6 (ii) of the Food Sanitation Act, sale of food items with radiation levels exceeding the set values were to be restricted, which they were.

Although speculation emerged that there was minimal initial food distribution to and within the affected areas due to a shortage of gasoline and fuel and due to the damage done to the transportation network by the earthquake and tsunami, food distribution restrictions and regulations were set up by local governments in the affected prefectures. In cases where food criteria had been exceeded or where, on the bases of monitoring results, violations appeared to be widespread, the distribution of food items were restricted.

FIGURE 2: Administrative system for food safety after the Fukushima accident in Japan



Based on Article 11 (1) (iii) of the Japanese Food Safety Basic Act, these restriction values were urgently determined, and they were in place even before the Food Safety Commission (FSC) carried out its first risk assessment (Assessment of the Effect of Food on Health). Based on the requirements of Article 11 (2) of the Food Safety Basic Act, a formal request for an “Assessment of the Effect of Food on Health” was made to the FSC Chairperson on March 20th by the Minister of Health, Labour and Welfare. In response to the request, the FSC Chairperson responded in all due haste by submitting an "Emergency Report on Radioactive Nuclides in Foods," to the Minister of Health, Labour and Welfare on March 29th. The emergency report stated that the provisional regulation values for iodine were “concluded, in the present situation, to be sufficiently safe.”[6] The Japanese government thereby decided on April 4th to maintain its regulation values. The FSC nevertheless believed that the report was assembled hastily and that the assessment of its scope needed to be expanded upon through additional consultations.

Provided this evaluation, the FSC subsequently carried out an additional risk assessment. For that particular risk assessment, a wide-range of publications on radioactive material were consulted, including reports on radioactive materials that had been produced by the Agency for Toxic Substances and Disease Registry (ATSDR), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the International Commission on Radiological Protection (ICRP), and the World Health Organization (WHO). These publications were categorized according to their various viewpoints and methodologies in order to identify the applicability of each assessment. The categories included the study design, the scale of each survey related to the existence or non-existence of statistical significance, the appropriateness of the estimated exposure amount, the influence of the confounding factors, and the presence of uncertainty referred to by the author. With this research in hand, the FSC submitted its second assessment report to the Minister of Health, Labour and Welfare on October 27th.[7]

On October 28th, the minister of Health, Labour and Welfare consulted with the Pharmaceutical Affairs and Food Sanitation Council in order to establish new limits for radionuclides in Japanese foods. The Pharmaceutical Affairs and Food Sanitation Council and its subcommittee had already begun discussions on a wide range of topics needed to set food safety limits. In the first months following the accident, the Pharmaceutical Affairs and Food Sanitation Council had examined the processes for assessing exposure, the type and range of foods categories to which limits should apply, the range of radionuclides which could be controlled by the limits, the development of feasible analytical methods, and the stage of food production to which the limits needed to apply. They had also discussed the proper dose criteria for long-term uses after a nuclear accident based on the ALARA principle for food safety (see Part I) and the proper ways to protect younger people and unborn children. The subcommittee of the Pharmaceutical Affairs and Food Sanitation Council compiled and submitted their proposal for new limits by December 22nd.[8] Their proposed limits were based on an annual dose criterion of 1

[6] Food Safety Commission of Japan. "Emergency Report on Radioactive Nuclides in Foods." (n.d.): n. pag. Web. 3 Nov. 2014. <https://www.fsc.go.jp/english/emerg/emergency_report_radioactive_nuclides.pdf>.

[7] Food Safety Commission of Japan (FSCJ). "Risk Assessment Report on Radioactive Nuclides in Foods (Working Group for an Assessment of the Effect of Radioactive Nuclides in Food on Health)." *Food Safety Commission of Japan*. N.p., Oct. 2011. Web. 3 Nov. 2014. <http://www.fsc.go.jp/english/emerg/abstract_risk_assessment_report.pdf>.

[8] Shigeru Takashi, Yamamoto. "Japanese Pharmaceutical Affairs and Food Sanitation Council Food Hygiene Subcommittee Report for Radioactive Material Measures; 薬事・食品衛生審議会食品衛生分科会." *Japanese Pharmaceutical Affairs and Food Sanitation Council*. N.p., 23 Feb. 2012. Web. 3 Nov. 2014. <http://www.mhlw.go.jp/stf/shingi/2r98520000023nbs-att/2r98520000023ng2.pdf>.

mSv per year. The dose coefficients, dose criterion used, and the equation for limits were all identical to those outlined in the current Codex General Standard for Contaminants and Toxins in Food and Feed (CODEX STAN 193-1995) (*1).

※ 4. The discussion paper of the RASSC working group explained the logic behind the Japanese limits and how the limits for the sum of radioactivity of Cs-134 and Cs-137 (Table 2) were determined. Their summary is as follows:

1. The annual dose criterion of 1 mSv/year, the dose coefficients used and the equation for deriving limits in Japan were all identical to those used within the current Codex guideline levels. The food categories used in Codex were also taken into consideration when the Japanese government established new limits.

2. The rationale for establishing limits for a sum of Cs-134 and Cs-137 is that even conservative estimations indicated that the contribution of radionuclides other than radioactive caesium was small: about 12% for the adult population (19 years and older). This low rate was also confirmed by the low percentage of radionuclides, other than radioactive caesium, dispersed into the air and also found in surface soil.

3. The limit of 10 Bq/kg for drinking water was taken by the Japanese government directly from the WHO Guideline for drinking-water quality.[9] Together with the assumed typical consumption rate of drinking water, this limit was expected to lead to a dose of approximately 0.1 mSv/y.

4. The limit of 100 Bq/kg for general foods, covering all foods except cattle milk, infant foods and drinking water, was calculated using the same formula outline in the current Codex guideline levels with the following factors:

- Ingestion dose coefficients for individual age groups (mSv/Bq)
- Food consumption per year of individual age groups obtained from surveys conducted in Japan (kg)
- Assumed rate of food contamination by radionuclides: 50%
- This value was taken from the food sufficiency rate on a calorie basis with conservative estimation
- The annual dose that can be used for foods: around 0.9 mSv/y (obtained by subtracting around 0.1 mSv/y for drinking water from 1 mSv/y)

5. The limits for infant foods, cattle milk, milk-based drinks and milk-based milk substitutes (but not including yoghurt or yoghurt drinks) were derived with an assumed contamination rate of 100% since many of these food items are produced in Japan.

[9] "Guidelines for Drinking-water Quality, Fourth Edition 2011." *World Health Organization (WHO)*. N.p., n.d. Web. 03 Nov. 2014. <http://www.who.int/water_sanitation_health/publications/2011/dwq_chapters/en>.

TABLE 2 - Limits for drinking water, cattle milk, infant foods and general foods for radioactive caesium, as used for both domestic and export purposes

Food commodity	Radio-Caesium Limit (Bq/kg)
Drinking water	10
Cattle milk (Including milk-based drinks and milk-based milk substitutes but excluding yoghurt or yoghurt drinks)	50
Infant foods	50
General foods (all foods other than the above)	100

On December 27th, the Minister of Health, Labour and Welfare presented the proposed limits to the Radiation Council of the Ministry of Education, Culture, Sports, Science and Technology. Over the course of six meetings, the council deliberated the regularity of the technical standards in radiation protection, and in a final report it endorsed the proposed limits in a presentation on February 16, 2012.

The timing of the Radiation Council's report was important as it followed closely after a public comment hearing that was held between January 6-February 4, 2012. At that time, a wide range of public opinion was presented to the Japanese government. During this public comment hearing, the largest of its kind, 1,877 opinions were heard from individuals representing consumers, manufacturers, distributors, food manufacturers, experts, inspectors, local authorities, and other groups. The Japanese Government compiled these opinions and the government's responses were then presented back to the public again. Beginning on January 16th, 2012 several joint risk communication events were subsequently hosted in-tandem by the Ministries of Health, Labour and Welfare, the Ministry of Agriculture, Forestry and Fisheries, the Food Safety Commission, and the Consumer Agency. At these events, which were held across the country, a wide range of opinions were again shared and discussed by the concerned parties, in much the same fashion as the initial public comment hearing. These joint risk communication events are still being carried out today on an on-going basis.[10] Concurrently, a WTO/TBT notification was carried out from the 17th of January to the 10th of February in order to give advanced notice of the new regulations to WTO member countries.

After considering the wide range of opinions from the concerned parties, the Pharmaceutical Affairs and Food Sanitation Council on February 24th compiled their final proposition on the new limits. On March 15, 2012, the Minister of Health, Labour and Welfare introduced the new limits. They entered into force on April 1, 2012. At the same time, several revisions were made to the analytical methods, screening test methods and monitoring guidelines. To ensure a supply of safe food items, a great number of production control efforts continue to be undertaken within the all food production and distribution sectors, and there have been very few instances of limits exceeding the specified values.

[10] "Food Risk Communication about Safety (Opinion Exchange Meeting Held); 食品の安全に関するリスクコミュニケーション(意見交換会開催状況)." *Japanese Ministry for Health, Labour, and Welfare*. N.p., n.d. Web. 3 Nov. 2014. <http://www.mhlw.go.jp/stf/seisakunitsuite/bunya/kenkou_iryou/shokuhin/riskcom/iken/index.html>.

The Japanese experience most explicitly demonstrates the value of pre-established criteria levels as a launching pad for aggressive action following a nuclear accident. Moreover, the evolution of the Japanese response reflected heavily the results of the numerous tests and monitoring studies conducted in the most immediately following the accident.

SECTION III: STUDIES IN TRADE ASPECTS

PART V: RADIATION PROTECTION, FOOD SAFETY, INTERNATIONAL TRADE

At issue currently is the task of isolating best-practice international standards related to radionuclides in food and drinking water, used in both emergency exposure and existing exposure situations, and how these standards may be situated into existing international trade law, practice, and experience. The NEA framework clarifies when and how concentration values can be used and it has become clear that greater capacity building among trade partners may be needed prior to accidents within the confines of the most relevant trade agreement, the Agreement on the Application of Sanitary and Phytosanitary Measures (henceforth referred to as "the SPS Agreement").

At the time of the accident at the Japanese Fukushima Daiichi nuclear facilities in 2011, several international standards related to radiation protection, particularly those for radionuclides in food and drinking water, had been well-established not just by the Codex Alimentarius Commission, but also several IAEA and ICRP publications. Each of these international bodies have worked to lay a foundation intended to guide national decisions in the process of authorising items from post-accident affected areas within a country for consumption, to be released to national and international markets, and for authorising the importation of items from post-accident affected areas in another country. At the 32nd Meeting of the IAEA Radiation Safety Standards Committee (RASSC) it was noted however that "these different activity concentration values, the criteria on which they are derived, and the circumstances under which they are intended to be applied are not always clearly understood by the international community." Some, for example, are intended to be applied in both emergency exposure and existing (post-emergency) exposure situations, others only in emergency exposure situations within affected countries, and more still relate only to food in international traded food following a radiological or nuclear emergency. These issues must be addressed

To get an understanding of how the NEA framework took shape, it is necessary to backup and first explore the background to the international trade system. The SPS Agreement, which entered into force in 1995 at the World Trade Organization (WTO) following the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), was expected to harmonize national regulatory differences around established international standards, most notably, those produced by the Codex Alimentarius Commission. The novel science-based requirements, as opposed to non-discrimination requirements, that were solidified into international trade law by the SPS Agreement were intended to act as a catalyst for that harmonization process. Nevertheless, the possibility of relegating complete regulatory authority to an international body has thus far been politically unacceptable for countries. By consequence, questions related to when food should be restricted following a nuclear or radiological emergency, how national criteria and export criteria are established, and when these criteria should be implemented remain unclear. The NEA framework helps to clarify some of these points.

Background; The SPS Agreement (WTO)

The SPS Agreement admits any domestic measures that a state may deem necessary for the protection of human life, in so long as it can be justified scientifically to the international community. Unlike other WTO disciplines, SPS Measures are not tethered to the non-discrimination principle of MFN (most favoured nation), which would otherwise oblige countries to adopt the same trade policies in relation to all WTO members. For this discipline, trading partners may have different conditions for allowing access to its market.[11] Within this context, considerable disagreement can arise between countries.

Those measures covered by the agreement include any law, decree, regulation, requirement, or procedure implemented by policy makers in order to protect human or animal life or health from risks posed by additives, contaminants, toxins, or disease-carrying organisms in food that may enter a country from beyond its borders. Thus, such measures are of great national importance in the aftermath of nuclear or radiological emergencies. The agreement is unique in that it "does not just abstractly refer to international standards" as the guiding source for these measures.[12] Three organizations are explicitly identified as the source of all international standards for the purposes of trade; the Codex Alimentarius Commission ("Codex") for standards related to food safety, the International Office of Epizootics (now the World Organization for Animal Health) for standards related to animal health, and the International Plant Protection Convention for standards related to plant health. These standards are identified in Annex A as the only relevant international standards for the international trade of food.[13]

The need for further investigation for post-nuclear accident food and water protection criteria and international trade becomes evident from the fact that "[n]o attempt is made in the WTO to agree to the substantive content of SPS measures or to define minimum standards," and instead "[t]his is left to the relevant international bodies" previously mentioned.[14] As has been discussed at RASSC previously, it is true that occasionally the need to organize the international standards and to give instruction to governments arises. Those attempts are carried out by several relevant international organizations. The NEA believes that its framework gives a broad overview and a conceptual idea of when the standards and criteria identified by those bodies should be used. There is no requirement within the SPS Agreement that stipulates that members adopt SPS

[11] Weyerbrock, Silvia, and Tian Xia. "Technical Trade Barriers in US/Europe Agricultural Trade." *Agribusiness* 16.2 (2000): 235-51. P. 239.

[12] Büthe, Tim. "The Globalization of Health and Safety Standards: Delegation of Regulatory Authority in the SPS Agreement of the 1994 Agreement Establishing the World Trade Organization." *Law and Contemporary Problems* 71.1, The Law and Politics of International Delegation (2008): 219-55. Print. P. 225.

[13] Ibid. P. 225.

[14] Hoekman, Bernard M., and M. M. Kostecki. *The Political Economy of the World Trading System: The WTO and beyond*. Third ed. Oxford: Oxford UP, 2009. Print. P. 256.

measures in any specified instances, and the WTO only establishes an agreed upon set of binding rules if members decide to implement SPS measures.[15] The NEA framework explicitly recognizes that public protection and export criteria are a matter of national choice in large part because WTO members have it within their authority to define technical regulations at the national level, and they are only required to notify other members when and where they have adopted national standards that diverge from those of the standard setting bodies.

Across different periods or situations involving the same food safety issue, members must be able to demonstrate a level of consistency within the measures that it adopts. In one of the earliest SPS disputes, a panel found an Australian ban on Canadian salmon to be in violation of the SPS "consistency requirement" (Article 5.5), which specifies that members avoid "arbitrary or unjustifiable distinctions in the levels it considers to be appropriate in different situations."[16] At times members are required to demonstrate what motivated divergent national standards to ensure that measures that are implemented are not disguised trade barriers or that they are arbitrary or discriminatory. Nonconforming standards can be challenged by other members in the WTO dispute settlement process.[17] In the case of SPS measure challenges, all divergent measures must be justified by scientific evidence.

These particular characteristics are of critical importance in the topic of food safety and trade following a nuclear or radiological emergency. In the short history since the founding of the WTO, fundamental disagreements have emerged over these measures and their related economic costs, reflecting differences in risk attitudes and broader domestic political pressures. Disagreements also followed the 2011 nuclear accident in Japan. In the summary minutes from a 2013 SPS Committee Meeting, Hong Kong and China, which have imposed import restrictions against Japan following the 2011 nuclear accident in Fukushima, explained that their import restrictions "were based on public health concerns over food imported from the five affected prefectures in Japan." At this WTO meeting, as indicated by the summary minutes, both countries made statements that they were "waiting for further information from Japan in order to fully assess the threat level presented by Japanese imports."[18] At the same meetings, the Japanese government notes frequently that the SPS Agreement permits importing countries to impose more restrictive import measures than those outlined international standards only when they have scientific base evidence.

The guideline levels[19] for radionuclides contained in the Codex standards apply to radionuclides contained in foods destined for human consumption, foods traded internationally, and foods which have been contaminated as a result of a nuclear or radiological emergency. The guideline levels, which are specified for three groups of radionuclides according to dose

[15] Hoekman, Bernard M., and M. M. Kostecki. *The Political Economy of the World Trading System: The WTO and beyond*. Third ed. Oxford: Oxford UP, 2009. Print. P. 252.

[16] Agreement on the Application of Sanitary and Phytosanitary Measures, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Article 5.5 - Results of the Uruguay Round vol. 1, 33 I.L.M. 1125, 1153 (1994).

[17] Hoekman, Bernard M., and M. M. Kostecki. *The Political Economy of the World Trading System: The WTO and beyond*. Third ed. Oxford: Oxford UP, 2009. Print. P. 257.

[18] WTO Secretariat, *Committee on Sanitary and Phytosanitary Measures, Summary of the Meeting of 27-28 June 2013*, G/SPS/R/71 (28 August 2013). P. 6.

[19] The Codex General Standard for Contaminants and Toxins in Food and Feed defines guideline level (GL) as "The maximum level of a substance in a food or feed commodity which is recommended by the CAC [Codex Alimentarius Commission] to be acceptable for commodities moving in international trade. When the GL is exceeded, governments should decide whether and under what circumstances the food should be distributed within their territory or jurisdiction."

coefficient values ($10^{-5}/10^{-6}$, 10^{-7}, and 10^{-8} Sv Bq^{-1}), are listed in the Codex General Standard for Contaminants and Toxins in Food and Feed (CODEX STAN 193-1995).[20] The guideline levels are grouped by two food groups, *Foods Destined for General Consumption* and *Milk and Infant Foods*, and they are intended to be used and applied by countries to control food traded internationally for the first year following an accident.[21] Most importantly, according to CODEX STAN 193-1995, when radionuclide levels in internationally traded food do not exceed the guideline levels of 1 mSv/y (ingestion) the food should be considered by importing nations as safe for human consumption. The 2013 EGRPF Sub-Group on Trade in Commodities and Food recognized the value and importance of international agreements on criteria, particularly Codex Standards, as does this report. The 2012 meeting CRPPH also highlighted that the ways in which international standards are used (e.g. Codex Alimentarius, BSS exemption values, IAEA transport values, EC post-Chernobyl emergency values, etc.) is not always understood. This dynamic will be explored further.

The SPS Agreement (WTO): - Needed for radiation protection but do weaknesses exist?

The SPS Agreement, and the recourse provided to countries by the WTO Dispute Settlement Body in the instance of non-compliance, is one of the most profound advances in agriculture trade cooperation, but the expected process of harmonization, which would reduce national differences and international barriers, has not been completed. SPS measures vary across a wide spectrum for each importing nation because of differences in cultural norms, social preferences and economic circumstance. Likewise, epidemiological risks vary as well. The risks posed to defined populations vary due to existing health and disease conditions, the existing environmental climate, and patters of ingestion habits. Some nations “seek tight protection while others readily consume riskier foods.”[22] For developing countries, in particular, “poor access to compliance resources, including scientific and technical expertise and finance, and a lack of awareness among officials about SPS requirements” makes the process of adhering to certain standards or creating them especially challenging.[23] The most obvious contemporary case related to these differences concerns the conflicting views and regulation of Genetically Modified Organisms (GMOs) on each side of the Atlantic. Nuclear energy producing countries have diverse barriers, domestic procedures, and import inspection systems for radiation food safety that can achieve the same level of protection against risk while developing countries are less likely to have a robust infrastructure in place for protection, including operational criteria or activity concentrations for combinations of radionuclides and food types.

The imposition of SPS measures, existing differences in adopted measures at various borders, and even misunderstandings or misinformation of these measures all have the potential to

[20] Codex Alimentarius Commission (CAC), *Codex General Standard for Contaminants and Toxins in Food and Feed,* CODEX STAN 193, (1995).

[21] Canadian Minister of Health, *Canadian Guidelines for the Restriction of Radioactively Contaminated Food and Water Following a Nuclear Emergency,* ISBN0-662-30278-8 (2000). P. 17.

[22] Victor, David (2002), “WTO Efforts to Manage Differences in National Sanitary and Phytosanitary Policies,” *UCIAS Edited Volumes, Dynamics of Regulatory Change: How Globalization Affects National Regulatory Policies,* 1:7 (2002). P. 1.

[23] Athukorala, P. and S. Jayasuriya (2003), “Food Safety Issues, Trade and WTO Rules A developing country perspective” *World Economy,* 26 pp. 1395–1416. P. 11.

affect trade flows and to cause considerable economic consequences. For a country grappling with an emergency exposure or existing exposure situation, overly burdensome import restrictions for its exporters that have cleared agreed-to safety inspections could greatly augment the overall existing hardship. At the WTO, Japan has regularly updated member states of the status on the ground. At a July 10-11, 2012 meeting of the SPS committee, Japan "thanked the international community for its co-operation and indicated that the infrastructure and economies of the affected regions were on a steady path to recovery and reconstruction."[24]

The strength of the SPS Agreement lies in the fact that importers must justify SPS measures based on scientific evidence and that any measured adopted must be the least restrictive measure possible. Both principals were solidified early in WTO history. Nevertheless, for the purposes of radiation protection, several aspects of the SPS Agreement will deserve inquiry. The Codex Alimentarius Commission, which is the bedrock standard setting body behind the SPS Agreement, has made international standards for radionuclides and has published a considerable array of recommendations to ensure food safety. It is widely understood on the international level that food safety cannot be achieved without thorough production management from the first steps of production all the way through to sale (see for example GAP, GMP, and HACCP). Many of these recommendations concern the production management of safe foods prior to export. At the same time, as the WTO Secretariat makes clear in its World Trade Report of 2005, although the protection of human or animal health are widely shared policy objectives, "disagreement may arise within or among societies about the desirable degree of protection to be achieved." The WTO Secretariat goes on to detail that disagreement may arise about "the existence of a link between a tradable good and the policy objective or about the true nature of that link." Most importantly, with respect to SPS Measures, "disagreement may arise about the effectiveness of a given policy instrument, like a standard, to achieve a certain policy objective."[25]

The SPS Agreement was developed with a more explicit goal of trade liberalization in mind. By consequence, the Codex Standards, as applied through the agreement, serve primarily to dictate which import restrictions, in the case of nuclear accidents, are prohibitively trade restrictive and are therefore prohibited by WTO law. While this applies to importation, no such "voluntary export prohibition" or obligatory export prohibition element exists within this current WTO-Codex regime, thereby adding credence to the need for a framework.[26] This is evident from the text of the SPS Agreement, in Annex A, which defines Sanitary or Phytosanitary measures to be any measure applied "within the territory of the Member from risks arising from the entry, establishment or spread" and any measure intended "to prevent or limit other damage within the territory of the Member." [27] In effect, SPS Measures are by definition used to protect the domestic market of a member state from entry of unsafe food.

The SPS Agreement in Article 4 does encourage the conclusion of equivalence agreements, of which more will be said below, so that an exporting member can "objectively

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[24] WTO Secretariat, *Committee on Sanitary and Phytosanitary Measures, Summary of the Meeting of 10-11 June 201*2, G/SPS/R/67 (11 September 2012). P. 4.

[25] WTO Secretariat, *World Trade Report 2005* (2005). P. P. XXXV.

[26] Ching-Fu Lin (2012), "SPS-Plus and Bilateral Treaty Network: A 'Global' Solution to the Global Food-Safety Problem," *Conference on International Health and Trade: Globalization and Related Health Issues*, held by the Asian Center for WTO & International Health Law and Policy in August 2011 in Taiwan. P. 709.

[27] Agreement on the Application of Sanitary and Phytosanitary Measures, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex A - Results of the Uruguay Round vol. 1, 33 I.L.M. 1125, 1153 (1994).

demonstrate" to the importing member that its SPS measures achieve the latter's appropriate level of protection, but there is no obligation or operational mechanism to conclude such agreements in the text.[28] This is particularly problematic because SPS measures have proven to be "more diverse across countries than product standards for manufacturers." As a result, they leave more scope for abuse, as norms can be defined by importers so strictly to ensure that some internationally trade food never satisfies them.[29]

The largest trade issues therefore that must be addressed following an nuclear or radiological accident include: (1.) that social and political factors, which are often motivated by consumers' views, may lead to prolonged trade restrictions against a nation affected by a nuclear accident, and (2.) within the existing trade and food safety framework, there is difficulty in synchronizing the actions of exporters, in post-nuclear disaster emergency situations, with the expectations and demands of importers concerning food quality and safety. To get an idea of these issues, consider that in an "Communication" sent to the SPS Committee on March 15, 2013, Japan raised its concern that "some countries still ban the import of Japanese food or set zero limits for radionuclides,"[30] which is both unnecessary and, in all practicality, unattainable.

Trade disputes at the international level can cause considerable economic damage. From the most recent nuclear accident, despite the best efforts of the Japanese government to rapidly regain credibility in the eyes of its closest diplomatic and trade partners, Japanese foods exports continue to face substantial restrictions by some regional trade blocs and states. While some nations have reported their "emergency" import restrictions on Japan to the SPS Committee of the WTO, several have continued to appeal to more ambiguous safety concepts, such as the "precautionary principle," and less concretely developed legal language to maintain certain trade policies. By examining the overlap, strengths, and gaps in trade and food safety cooperation, the NEA hopes to further develop its framework for understanding the governance challenges presented by a future nuclear accident in a world of increased international trade and for how best to ensure optimal consumer radiation protection levels.

The Equivalence Principal

Recall that SPS measures are trade based and broadly incorporate all "relevant laws, decrees, regulations, requirements and procedures including, *inter alia*, end product criteria; processes and production methods; testing, inspection, certification and approval procedures" that are applied to protect human health or animal life from the risks associated with the entry of additives, contaminants, toxins, or disease-carrying organisms across international borders.[31] The negative impact of divergent measures standing at different borders, including, for example, those used for protection against radiation exposure, can create considerable costs. Measures that grow

[28] Prévost, Denise (2010), "Sanitary, Phytosanitary and Technical Barriers to Trade in the Economic Partnership Agreements between the European Union and the ACP Countries," *ICTSD EPAs and Regionalism Program*. P. 35.

[29] Hoekman, Bernard M., and M. M. Kostecki. *The Political Economy of the World Trading System: The WTO and beyond*. Third ed. Oxford: Oxford UP, 2009. Print. P. 250.

[30] WTO Secretariat, *Committee on Sanitary and Phytosanitary Measures, Current Status after the Nuclear Power Plant Accident*, Communication from Japan, G/SPS/GEN/1233 (15 March 2013). P. 2.

[31] Agreement on the Application of Sanitary and Phytosanitary Measures, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex A - Results of the Uruguay Round vol. 1, 33 I.L.M. 1125, 1153 (1994).

increasingly aligned in all likelihood reduce those costs, but the process of harmonizing divergent measures at the international level can be politically challenging. Rather than confronting these factors head-on, the SPS Agreement provides a pathway for different SPS measures and protective strategies, in different places, to achieve the same level of protection and to be "equally effective in reducing risk." In theory, so long as an *exporting* country can "objectively" demonstrate its ability to achieve the same level of protection against risk as the measure imposed by the *importing* country it should be reasonable for importing countries "to rely on the SPS requirements and control and inspection systems in place in exporting countries, even where these may be different from their own."[32] Within the legal language on international trade, this particular normative goal is known as the "acceptance of equivalence" or the equivalence principal, and it is outlined in Article 4 of the SPS Agreement:

> **"Members shall accept the sanitary or phytosanitary measures of other Members as equivalent, even if these measures differ from their own or from those used by other Members trading in the same product, if the exporting Member objectively demonstrates to the importing Member that its measures achieve the importing Member's appropriate level of sanitary or Phytosanitary protection. For this purpose, reasonable access shall be given, upon request, to the importing Member for inspection, testing and other relevant procedures."[33]**

At first, the equivalence principal seems to contradict the notion that no voluntary export prohibition or obligatory export prohibition element exists within the current WTO-Codex regime. In this Article, the exporting country does in fact carry the burden of proving that its measures "objectively" achieve a certain level of protection. The process of two member states recognizing each other's SPS measures, however, requires that upon the request of one of the parties the two "enter into consultations with the aim of achieving bilateral and multilateral agreements on recognition of the equivalence." In the language, there exists no operational method for the provisions of the article to come into action or for these consultations to begin. The WTO SPS Committee has recognized the drawbacks in Committee Decisions, and one published in 2004 affirmed that the Committee wished "to make operational the provisions of Article 4," and that it recognized "that members have faced difficulties applying the provisions of Article 4."[34]

What will become evident is that exporting and importing countries can often struggle to ascertain how various measures will meet the level of protection needed to be recognized as equivalent by trade partners. Disagreements over the science underlying any protective measure and involved in meeting specified levels of protection can also emerge.

[32] Prévost, Denise (2010), "Sanitary, Phytosanitary and Technical Barriers to Trade in the Economic Partnership Agreements between the European Union and the ACP Countries," *ICTSD EPAs and Regionalism Program*. P. 34.

[33] Agreement on the Application of Sanitary and Phytosanitary Measures, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Article 4.2 - Results of the Uruguay Round vol. 1, 33 I.L.M. 1125, 1153 (1994).

[34] WTO Secretariat, *Committee on Sanitary and Phytosanitary Measures, Decision on the Implementation of Article 4 of the Agreement on the Application of Sanitary and Phytosanitary Measures*, G/SPS/19/Rev. 2 (23 July 2004). P. 1.

Information Asymmetry

In examining some of the general motives driving food import regulation at the domestic level, it becomes clear why cooperation at the international level is exceedingly challenging and why the existing trade and food safety framework for radiation protection has problems, on some level, synchronizing the actions of exporters, in post-nuclear disaster emergency situations, with the expectations and demands of importers concerning food quality and safety. As described above, it appears that the principal trade issues concerning foods from post-accident affected area are partly rooted in consumers' perception (often a sense of fear and distrust) of radiation exposure, which in turn may drive larger political and social motives and the expectations and demands of importers concerning food quality and safety. As was true in the aftermath of the Japanese accident in 2011, the results of these motives may be scientifically unjustified and may lead to prolonged trade restrictions against a nation affected by a nuclear accident. These problems have previously been identified as likely characteristics of radiation exposure situations in particular.

At a basic level, the SPS standards and the related trade measures used to enforce them are introduced by governments in the interest of society to achieve fundamental social objectives related to the protection of public, animal and plant health and even to a large extent the environment. Those fundamental social objectives repeatedly go unmet in the private market because of the economic mechanics driving trade in food.

SPS Measures are intended to address issues related to market failure involved with imperfect information for consumers on food safety. In a world of perfectly adjusting markets and complete information, consumers around the globe would reliably shift consumption patterns away from *identified* foods, producers, or even countries where safety cannot be guaranteed, or worse that have failed the basic expectation for safety in the past. Producers of those products, in those states, would be forced to adapt to higher standards or they would be pushed out of the market. In reality however, a large asymmetry exists between not only the information that consumers have concerning the food that they consume, but also their knowledge of the risk involved. Consumers face a daunting task in determining the levels of food-safety standards adopted by various states and the level of compliance by domestic producers of those standards. In addition, in cases related to nuclear or radiological emergencies in particular, consumers face the task of filtering out the explosion of misinformation and rumour. Making matters worse for most food safety incidents is the changing dynamics of international trade that include greater diversification and much more stratification of production processes across multiple borders. In general, food producers and manufacturers today face "slight or non-existent reputational constraints because [they are] several links in the supply chain-and possibly thousands of miles away from consumers."[35] When goods are harvested or produced within supply chains, stretching across countries and continents, reputational effects for individual producers and manufacturers "are muted at best."[36] This particular dynamic is less applicable to situations following nuclear or radiological emergencies however, given the overwhelming amount of attention that consumers would give to food stuff emerging from affected areas.

[35] Bamberger, Kenneth A. "Keeping Imports Safe: A Proposal for Discriminatory Regulation of International Trade." *California Law Review* 96.6 (2008): 1405-445. P. 1415.

[36] Ibid. P. 1415.

The first principal challenge related to consumers' perception stems from the fact that "food safety issues can raise production costs, influence reputation, and close off international markets."[37] The consequences of consumer perceptions can affect firms, entire industries or commodities, or the volume of exports of an entire country. On one level, even if, for example, a large foodborne illness or food safety incident was linked to the imports of a specific commodity emerging from an identified country, the global demand for that commodity itself can drop considerably over concerns for safety. On another level, even if a large foodborne illness or food safety incident was linked to one specific region or, further, to a few select farms or producers within a country, demand for that country's entire exports can suffer. The reputational impact of contaminated imports on trade can most visibly be seen by the case of US imported Guatemalan raspberries associated with *Cyclospora.* An outbreak of Cyclospora in the US in 1996 was initially, and falsely, attributed to California strawberries. The implication alone shattered the reputation of California strawberries, according to the California Strawberry Commission, and cost growers in the central coast of California $16 million in lost revenue.[38] The outbreak of Cyclospora was later attributed to Guatemalan raspberries.[39] Over the course of several outbreaks that followed, "the Guatemalan raspberry industry shrank from 85 producers to three."[40] Other similar examples include a case of US imports of Mexican strawberries associated with Hepatitis A (contaminated either in Mexico or the United States), and US imports of cantaloupe from Mexico associated with Salmonella. What is most important to note about these cases is that it is now believed that the contamination occurred at the grower or shipper level and each country as a whole faced the repercussions.[41]

At least from an international trade perspective, the potential consequences of reputational costs associated with food safety incidents can be very large. The NEA in its framework can account for this dynamic, though the framework was motivated by public health purposes, by highlighting that national governments, following a nuclear or radiological emergency, will most likely apply the same criteria for food and water in the affected area, in national areas not affected by the accident, and for export. The NEA framework outlines that national criteria will be developed to protect the most affected group, those living in the affected territories. A unified safety approach by the country facing a nuclear or radiological emergency can assuage consumers of the safety of the food emerging from the entire country.

The second of these challenges related to the perception of consumers is tied directly with the first one but emerges from the rapidly evolving situation affecting a country in an emergency and existing exposure situation. The NEA framework recognizes that the criteria for the management of trade in food, consumer products and commodities coming from accident-affected areas, both during the emergency phase and afterwards, would likely evolve over time. Food consumption and trade will be managed somewhat differently in the early, uncertain period of an accident than in the longer-term period when contamination levels and control or measurement mechanisms are in place. These evolving characteristics can have an effect on perception and they must be addressed.

[37] Buzby, Jean. "International Trade and Food Safety: Economic Theory and Case Studies." *Agricultural Economic report No. (AER-828)*. United States Department of Agriculture, Economic Research Division, Washington DC (2003). P. 1.

[38] Ibid. P. 80.

[39] Ibid. P. 6.

[40] Ibid. P. 3.

[41] Ibid. P. 76.

In the instance of radiation protection, the greatest hindrance to trade came from not only asymmetric information, but also from consumer aversion within importing countries. It follows logically that if consumers make demands of their governments for greater food safety, yet have little or a misinformed understanding of risks, there is a greater chance that trade restrictions will be put in place by policy makers that are overly restrictive and not correctly scientifically informed. Several countries imposed stricter SPS measures and import restrictions than the criteria issued by the Japanese government, despite the fact that its criteria were based on long-term protection of the most exposed group after the Fukushima nuclear accident. Most of these countries have the domestic capabilities to scientifically judge the situation. The data in Part I show that the ratio of Japanese foods that exceeds national standards is low, and that the monitoring system of the Japanese government is successfully working. Nevertheless, some import restrictions around the world have been kept in place, and this seems to be in some part due to the information dilemma.

Given this discussion on consumer information, it becomes increasingly clear why the NEA framework stipulates it will be socially, politically, legally, and perhaps ethically difficult for a national government in an accident country to justify the use of different criteria, either higher or lower, for its own population than for populations in other countries. The EGRPF Sub-Group outlined that a single set of criteria (levels in Bq/kg or Bq/L), based on long-term protection of the "most exposed group" (e.g. those living in the contaminated area), should be used to manage all consumption and trade in food because they thought single set criteria would undoubtedly be enough for radiation protection. At the same time, a single set of criteria can also reduce the asymmetry in information and help to reduce the growth of misinformation.

Expectations

Governments take a very active role in fulfilling this market failure related to information, particularly as it relates to food and radiation protection. Food safety cooperation at the international level, including the establishment of SPS standards (and other associated technical recommendations such as those issued by the ICRP or standards issued by the IAEA), provides additional assurance to consumers that the food they consume is of an acceptable quality. The equivalency principle of the WTO SPS Agreement outlined above, at first glance, should further reduce the cost of uncertainty that consumers face in assessing a product by not only guaranteeing that products have been withstood scrutiny at the point of export and import but also by making the process of wading through different regulations less burdensome and less costly for consumers.

International trade experience has thus far demonstrated the difficultly in aligning the expectations for food safety by importing nations and exporting nations in food safety incidents. To understand why it is imperative to recognize, in addition to the information asymmetry outlined above, that unfortunately, at a more micro-level, trading partners have difficulty in "ascertaining the level of protection that their measures must meet in order to be recognized as equivalent." Exporters frequently do not have the domestic capacity to meet the level of scientific proof demanded by importers as the "objective" demonstration of equivalence.[42] This is often the

[42] Prévost, Denise (2010), "Sanitary, Phytosanitary and Technical Barriers to Trade in the Economic Partnership Agreements between the European Union and the ACP Countries," *ICTSD EPAs and Regionalism Program*. P. 35.

case when developing countries attempt to gain market access for their domestic producers in developed countries. On the opposing side of the trade relationship, importers suffer from a lack of familiarity with an exporting country's SPS regulatory system and "its effectiveness in addressing risk."[43] As a result, at both sides of the trade relationship, a lack of confidence can develop that the level of safety aimed at by the other country will actually be met. This is not to suggest that either of these dynamics were necessarily present following the Fukushima nuclear accident in 2011, but instead to demonstrate that even within the well-defined rules of the SPS Agreement considerable conflict can arise, which policy makers need to be cognizant of in the aftermath of any future accident.

Future Accidents and Other Challenges it May Pose

In future nuclear or radiological emergencies, other challenges may emerge that could prevent an affected country from acting as efficiently and diligently as the Japanese government. SPS measures may be erected quickly for a number of conceivable reasons. Where the SPS Agreement's equivalence principal is recognized, it is mostly between developed countries with sophisticated SPS regulatory systems and similar levels of SPS capacities. As it relates to this report, it can reasonably be assumed that countries with nuclear energy producing capabilities are also those with relatively sophisticated SPS regulatory systems. Even with well-developed regulatory systems in place however, countries may use more indiscriminate SPS measures to hold on until more information concerning the emergency becomes clear. This is one reason why in its recommendation, the NEA proposed that food should be restricted during the emergency phase and permission to eat and trade should be granted only after measurement or certification processes have been established. The relevant legal text in this case can be found in Article 5.7 of the SPS Agreement;

> **"In cases where relevant scientific evidence is insufficient, a Member may provisionally adopt sanitary or phytosanitary measures on the basis of available pertinent information, including that from the relevant international organizations as well as from sanitary or phytosanitary measures applied by other Members. In such circumstances, Members shall seek to obtain the additional information necessary for a more objective assessment of risk and review the sanitary or phytosanitary measure accordingly within a reasonable period of time."[44]**

Consider that the amount of agricultural goods crossing international borders and how there is no practical or financial way for any one country to inspect more than a tiny fraction of imports. In the United States for example, the Food and Drug Administration (FDA) inspects only 1% of food from foreign countries, and that is for a country where approximately 9.1 million imported food shipments enter, of approximately $2 trillion worth of products, from more than

[43] Ibid. P. 36.

[44] Agreement on the Application of Sanitary and Phytosanitary Measures, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Article 5.7 - Results of the Uruguay Round vol. 1, 33 I.L.M. 1125, 1153 (1994).

150 countries.[45] In its capacity in 2006, the FDA was able to visually inspect roughly 115,000 shipments, which resulted in 20,000 samples needing laboratory analysis.[46] Likewise, the great majority of the 1.5 billion euros worth of third country imported agriculture goods into the EU "is not subject to systematic controls at border inspection posts."[47] These controls are mostly implemented by developed countries. Controls are formulated with calculations that assume that individuals eat enough foods containing hazards that they reach the "maximum level of limits" every day. These numbers may seem extreme on the surface, but they are less so when taking into account that sampling plans are calculated with statistical consideration, which means that consumer's risk of sampling bias are carefully taken into consideration. The controls and SPS measures for developing countries are less refined however, and for developing countries, the necessary infrastructure needed to satisfy domestic demands for safety may often be insufficient.

Countries may have heightened scrutiny of the SPS measures adopted by exporting countries in the aftermath of future radiological or nuclear accidents. It is possible that more indiscriminate and complete import bans could be resorted to as a sort of last available resource when information is still surfacing. If an importing country has even the smallest inclination that a food-exporting country may have inadequate preventive measures or that they do not have complete information or control abilities, regulators will likely feel greater pressure "to impose stringent border inspections at their own expense in order to protect the health and lives of their citizens."[48] In practice, the behaviour has been witnessed before. It is common to ban products from an entire country, for example, where it has been established that a pest or disease exists, even if its prevalence is limited to certain regions. In one instance soon after the SPS Agreement was adopted, the European Union imposed a complete ban on fishery products emanating from Bangladesh from August to December in 1997 because it did not completely understand the hygienic standards existing in the country's processing facilities.[49] In an SPS Committee meeting as late as 2013, South Korea indicated that its fishery import restrictions, including a ban on imports from eight prefectures and additional testing and certification requirements in all cases where radioactive Caesium was detected, "were within accordance with Article 5.7 of the SPS Agreement," as a result of insufficient scientific evidence and the time needed to "come to a final determination."[50] Provided that the number of samples exceeding the limit of 100 Bq/kg had drastically decreased both in the Fukushima prefecture (from 53% in March/June 2011 to 2.2% in July/September 2013), Japan, in the same meeting, made mention of the fact that SPS measures must not be used arbitrarily.[51]

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[45] Bamberger, Kenneth A. "Keeping Imports Safe: A Proposal for Discriminatory Regulation of International Trade." *California Law Review* 96.6 (2008): 1405-445. P. 1406-17.

[46] Ibid. P. 1415.

[47] Alemanno, Alberto. "Solving the Problem of Scale: The European Approach to Import Safety and Security Concerns." *Import Safety: Regulatory Governance in the Global Economy*. Ed. Cary Coglianese, Adam M. Finkel, and David Zaring. Philadelphia: U of Pennsylvania, 2009. N. pag. Print. P. 171.

[48] Ching-Fu Lin (2012), "SPS-Plus and Bilateral Treaty Network: A 'Global' Solution to the Global Food-Safety Problem," *Conference on International Health and Trade: Globalization and Related Health Issues*, held by the Asian Center for WTO & International Health Law and Policy in August 2011 in Taiwan. P. 709.

[49] Cato, J.C. & Lima dos Santos, C.A. "European Union 1997 Seafood Safety Ban: the Economic Impact on Bangladesh Shrimp Processing." *Marine resource Economics*, 13(2): 215-227.

[50] WTO Secretariat, *Committee on Sanitary and Phytosanitary Measures, Summary of the Meeting of 16-17 October 2013*, G/SPS/R/73 (15 January 2014). P. 7.

[51] Ibid. P. 7.

The SPS Agreement gives priority to science, but both episodes demonstrate the importance, in the context of food safety, radiation protection, and trade following a nuclear accident, of what can happen if a more robust institutional framework for managing the expectations of what constitute quality standards is not developed. Fortunately, with respect to radiation exposure in foods going forward, extensive scientific knowledge, including large amounts of epidemiological data, is available, which makes this possible.

PART VI: WIDER ECONOMIC CONCERNS: WHAT ARE THE EFFECTS OF A NUCLEAR ACCIDENT ON GLOBAL AGRICULTURE COMMODITIES?

The central focus here remains in developing a framework for radiation protection, food safety, and international trade cooperation following a nuclear accident, but several additional topics must be explored. These additional topics will serve primarily to highlight the relevant hurdles that could hinder cooperation, to situate the framework within a broader global perspective and to develop how this framework could be linked with other studies in the future. As mentioned, the end goal here is to isolate best-practice international standards related to radionuclides in food and drinking water, and how these standards may be situated into the existing international trade regime.

Complicating the process for developing a viable framework for food safety following a nuclear or radiological emergency is that the global trading system in agriculture, by its very nature, "typically exhibits a significant degree of volatility."[52] Because of its unpredictability, the trading system in agriculture has remained reliably "non-transparent, discriminatory, and highly distortive" for much of the 20th century and today.[53] The deadlock over agriculture at the level of multilateral trade negotiations is all the more puzzling given that agriculture accounts for only a small share of global trade and an even smaller share of the GDP of rich countries – less than 5 percent.[54] In the last decade, commitments at the WTO have facilitated greater international cooperation, but countries have grown gradually more reluctant to lower agriculture protection given their concern with the impact of long-term rising prices on domestic food security. Those concerns burst through the seams in 2007 and 2008 when global maize and wheat prices doubled and rice prices tripled.[55] As a result of these recent developments, any proposed framework for trade cooperation related to agriculture goods following a nuclear or radiological emergency is bound to attract interest and a heightened degree of scrutiny.

The need to also situate this framework for radiation protection, food safety, and international trade within a greater perspective of commodity prices and markets is clear given the wider macroeconomic and trade consequences that an accident may bring about. Shocks in the supply or demand for commodities can alone trigger price surges, but policy choices can also play

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[52] Tangermann, S. (2011). Policy Solutions to Agricultural Market Volatility-A Synthesis. Draft Report for OECD. P. 5.

[53] Chauffour, Jean-Pierre. "Global Food Price Crises: Trade Policy Origins and Options." Poverty Reduction and Economic Management Department. The World Bank, Washington DC (2008). P. 1.

[54] Hoekman, Bernard M., and M. M. Kostecki. *The Political Economy of the World Trading System: The WTO and beyond*. Third ed. Oxford: Oxford UP, 2009. Print. P. 301.

[55] Meltzer, Joshua. "Improving Indian Food Security: Why Prime Minister Modi Should Embrace the World Trade Organization." The Brookings Institution. N.p., 16 May 2014. Web. 03 June 2014.

a vital role in determining price behaviour.[56] To the first point, if an accident of a certain magnitude occurred in a state with sizeable global or, more likely, regional market presence in a certain agriculture commodity, it is conceivable that the price for that commodity could witness considerable fluctuation, particularly for certain importers. Provided the innumerable macroeconomic factors involved in that type of scenario, both observable and not, a separate study would be required to examine specifics of any connection, and its magnitude, between an accident and prices. Secondly, as the EGRPF indicated in its report, import restriction policies are likely to be erected in response to a nuclear or radiological accident and during an emergency phase when the situation is uncertain. By consequence, trade cooperation following an accident is vital not only because an accident could provide a shock to the supply of an individual commodity but because the specific policy response following an accident could add notable repercussions and outsized costs as well.

At the outset, for the purposes of this report, it is imperative to distinguish between longer-term trends in global agriculture markets that have forced up prices over the last decade and short-term, unexpected supply shocks that cause volatility on agricultural markets. As will become evident, short-term shocks are most similar to the possible effects that could result from a nuclear accident. On the longer-term scale, climate change, diminishing land area for cultivation, rising energy prices, policy mandates for biofuels, the depreciation of the US dollar, and growing demand in large emerging economies have been singled out as potential causes for continued and potentially more permanent price increases. Much of the volatility witnessed on global agriculture markets however results from natural factors, most obviously from unforeseen changes in weather. Unlike the longer-trends listed, supply shocks resulting from weather, from flooding or drought for example, tend to be specific to individual regions and specific to individual years and periods within the production cycle.

The Economics

Worldwide agricultural production takes place in what is often referenced as one of the most inefficient, thin, and insulated markets. This renders global trade in food products less resilient to exogenous shocks in supply or demand, such as one that could be produced hypothetically by a nuclear accident, and less able to handle any volatility in output. In evaluating global agriculture commodity markets, the term “thinness” typically refers to the volume of trade in any particular good relative to overall global production. While the questions of whether global agriculture commodity markets have become thinner over time remains open to debate,[57] what remains clear is that international trade, in any good and at any volume, mitigates price movements. Trade smooths production and consumption “across space” by moving goods from surplus to deficit regions.[58] When international trade is disrupted by trade policy, other man-made measures or natural events, and goods no longer move efficiently from surplus to deficit regions

[56] Rapsomanikis, George, and Alexander Sarris, eds. "Commodity Market Review 2009–2010." *FAO Trade and Markets Division*, Rome (2010). P. 8.

[57] Liapis, P. (2012), “Structural Change in Commodity Markets: Have Agricultural Markets Become Thinner?” OECD Food, Agriculture and Fisheries Papers, No. 54, OECD Publishing.

[58] Ibid. P. 8.

according to demand and supply, prices become more vulnerable and volatile.[59] A greater volume of trade can mitigate the effects of an exogenous shock, such as a change in demand or supply. With commitments locked in at the WTO on agriculture goods and an ever increasing amount of goods moving due to changes in technology and transportation, exports in agriculture goods appear to be rising as a share of production. International markets are expected to become more liquid and more able to absorb production or consumption shocks in the future.

Compounding matters for trade in agriculture goods is the fact that production takes place over a considerable period of time and, as such, supply and demand cannot re-equilibrate immediately after a shock.[60] On both the output and the input side, there is typically a "one-year lag in the response of agricultural production to price signals."[61] Typically a rise in price for a good, for example, would suppress demand, but for agricultural goods it is different. Individuals around the globe always need food for survival. Agriculture goods remain central to daily expenditure even in the event of more considerable increases in price, and for that reason demand stays relatively consistent. Price "elasticities," or the responsiveness of supply and demand to any price changes, are generally small relative to scenarios where there was no lag. By consequence, for global markets to re-establish equilibrium in the short-run after a supply shock, prices have to adjust rather strongly to reallocate an excess or shortfall of supply. As Liapas (2012) makes clear, with relatively small price elasticity, as just outlined, small changes in supply and demand in trade can lead to "significant price changes."[62]

To fully understand the global balance of supply and demand in agriculture goods, the interaction of the storability of grains on overall supply must also be factored in. Given the importance of securing affordable agriculture goods to their domestic populations, governments frequently adopt measures to ensure a portion of seasonal output is set aside for future consumption. Recent price fluctuation episodes, notably those of 2008, revealed that price responses to changes in supply vary substantially with the level of available stock supplies. When the aggregate supply of these domestic stocks is high, a modest reduction in overall supply can be tolerated by drawing on discretionary stocks. But when stocks decline to minimum levels, a modest supply reduction can cause a price spike. When aggregate stocks decline to "minimal feasible levels," as a result of other shocks, prices become "highly sensitive to small shocks, consistent with the economics of storage behaviour."[63] Nuclear accidents of the magnitude that cause severe radiological food contamination are themselves highly unlikely, and the possibility that a region or state would face a sequence of events leading first to the overall reduction of stocks in agriculture staples and later to a nuclear disaster that would affect the same supply is also extremely small.

In most instances, world output of a given agricultural product is "far less variable than output in individual countries."[64] Output effects are more often magnified at a regional level. As

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[59] OECD-FAO (2011), "OECD-FAO Agricultural Outlook 2011-2020", OECD Publishing and FAO. <http://dx.doi.org/10.1787/agr_outlook-2011-en>.

[60] Tangermann, S. (2011). Policy Solutions to Agricultural Market Volatility-A Synthesis. Draft Report for OECD. P. 3.

[61] Ibid. P. 14.

[62] Liapis, P. (2012), "Structural Change in Commodity Markets: Have Agricultural Markets Become Thinner?" *OECD Food, Agriculture and Fisheries Papers,* No. 54, OECD Publishing. P. 6.

[63] Wright, B. D. (2011), "The Economics of Grain Price Volatility." *Applied Economic Perspectives and Policy* 33.1:32-58. Web. P. 33.

[64] Tangermann, S. (2011). Policy Solutions to Agricultural Market Volatility-A Synthesis. Draft Report for OECD. P. 56.

Brooks, et al. (2013) point out, the patterns of trade in agricultural commodities can best be characterized by regional or bilateral clusters. That is to say, in most instances one individual country is the top producer and exporter for a commodity within a specific region. Lower producing countries nearby, or countries with historic trade relationships to that top producer, are thereby relatively more dependent on that top producer for imports of that commodity. The level of integration or “connectedness” between the domestic markets of two trading partners, in turn, dictates “how fast and how fully price changes in one market induce a flow of goods between the markets.”[65] These patterns of trade are also largely why the NEA proposes that national criteria be developed to protect the most affected group, those living in the affected territories, perhaps at a level of 1 mSv/a if reasonable. As agriculture goods coming from an affected area are exported onto international markets, they are mixed among the exports of other countries thereby reducing the possibility for similar levels of exposure that the domestic population of the affected country is experiencing.

The fewer the number of top producing and exporting countries in any commodity market the greater the possibility for exposure to variability in exportable supplies in international markets for that commodity.[66] While effects at the state level can most often be expected to be cancelled out on a worldwide level, issues at the regional level, such as adverse weather, have proven to be a major contributor to global commodity price spikes within the last several years. A shock from a future nuclear or radiological emergency has the potential to do the same if severe enough.

Trade Policy

The trade policy response of importers and exporters following a nuclear or radiological emergency is of particular concern given that in the case of nuclear of radiological emergencies, global demand may already be supressed given the information asymmetries or misunderstandings outlined above. It has been well-documented that trade policies such as import tariffs, export taxes, and quotas impede the global price transmission passed between consumption and production. If international prices are not passed through borders, demand and supply responsiveness will be hindered or diminished. The NEA framework notes that restrictions on exports will likely be put into place immediately by the country affected by the accident and that importers will similarly take quick action. The Organization for Co-operation and Development (OECD) has before reported that the failure of international prices to pass across borders is most evident “when restraints are introduced by major exporters and when [restraints] are not notified in advance and [they are] uncertain in duration.”[67] Nuclear accidents are rare but they happen without forewarning, and, as the NEA framework makes clear, the duration of trade restrictions depends heavily on the developing circumstances on the ground.

[65] Brooks, Douglas and Ferrarini, Benno and Go, Eugenia C., “Bilateral Trade and Food Security,” Asian Development Bank Economics Working Paper Series No. 367 (September 2013). P. 2.

[66] Rapsomanikis, George, and Alexander Sarris, eds. "Commodity Market Review 2009–2010." *FAO Trade and Markets Division*, Rome (2010). P. 8.

[67] OECD-FAO (2011), “OECD-FAO Agricultural Outlook 2011-2020”, OECD Publishing and FAO. <http://dx.doi.org/10.1787/agr_outlook-2011-en>. P. 63.

According to Tangermann (2011), one of the biggest contributors to the price spike of 2006-2008 was government actions, and in particular export restrictions.[68] The larger issue at stake in the NEA framework relates to import restrictions, but the effects are largely the same. In the context of understanding the overall consequences of erecting border measures in response to nuclear accidents, it is important to note that border measures not only increase the domestic price of commodities, thereby reducing domestic consumption, but the resulting impact on production and consumption disadvantages producers in other countries, which in case would be the producers in the affected country.[69]

Exacerbating volatility on international markets are the strong "knock-on" effects that agriculture commodities have on one another. As states introduce various protective trade measures, the prices for all commodities are in some way affected because most, including wheat, rice, and corn, are "highly substitutable in the global market for calories."[70] In the United States, for example, a 23% expansion in available maize area in 2007 resulted simultaneously in a 16% decline in soybean area. The reduced in soybean production reportedly contributed to a "75% rise in soybean prices from April 2007 to April 2008."[71] To that extent, given this link, it is even conceivable that a sizeable nuclear accident would have a reverberating effect not only on a staple that is for which a country has a comparative advantage, but even other agriculture commodities produced in other places.

Notable Examples

The possibility for larger, most likely, regional effects on agriculture commodity markets following a nuclear or radiological emergency seems less farfetched after examining other incidents related to food security of the last several years. The first decade of the 21st century was wrought with nerve-rattling price increases that carried on persistently for the most important worldwide staples, such as rice, wheat, and maize. Before the decade was over, there had been several large shocks. At the height of the global financial crisis of 2008, prices soared. Agriculture commodity markets calmed by 2010, but extreme weather conditions quickly demonstrated that "agriculture remain[ed] susceptible to extreme volatility."[72] In a 2011 joint publication on the outlook for agriculture over the next decade, the OECD and the Food and Agriculture Organization (FAO) of the UN cited drought as the cause for a pronounced reduction in the grain harvest in the Russian Federation and Ukraine and for an almost 5% decline in world wheat production or "the largest fall since 1991."[73] Grain harvest was reduced by a third. In another instance, severe flooding in North-Eastern Australia greatly affected sugar while also forcing a

68 OECD-FAO (2011), "OECD-FAO Agricultural Outlook 2011-2020", OECD Publishing and FAO. <http://dx.doi.org/10.1787/agr_outlook-2011-en>. P. 23.

69 Chauffour, Jean-Pierre. "Global Food Price Crises: Trade Policy Origins and Options." Poverty Reduction and Economic Management Department. The World Bank, Washington DC (2008). P. 2.

70 Wright, B. D. (2011), "The Economics of Grain Price Volatility." *Applied Economic Perspectives and Policy* 33.1:32-58. Web. P. 33.

71 Mitchell, D. (2008), "A note on Rising Food Prices." Policy Research Working Group No. 4682. The World Bank, Washington DC.

72 OECD-FAO (2011), "OECD-FAO Agricultural Outlook 2011-2020", OECD Publishing and FAO. <http://dx.doi.org/10.1787/agr_outlook-2011-en>. P. 18.

73 Ibid. P. 18.

downgrading of much of the country's wheat to animal feed quality.[74] In a clear demonstration of the possible policy responses outlined above, the Russian Federation promptly imposed a ban on grain exports in 2010. In only a matter of months, the initial forecast for 2010 world cereal yield, "initially expected to be the second highest on record," had to be revised downward by roughly 31 metric tonnes (Mt). For those importers with heavy market integration of cereal with Russia, the downward revision was considerable. The joint OECD-FAO report indicates that 2010 production fell 1.4% below 2009 levels largely as a result of the weather.[75]

Again in the summer of 2012, global cereal markets faced severe market disruption, but this time the root cause emerged in the United States. As reported by the OECD and FAO, dry weather conditions caused one of the most severe drought periods that the United States has ever seen. The United States Department of Agriculture (USDA) highlighted that drought conditions affected nearly 80% of US agricultural land.[76] As a result, production dropped considerably in the United States, and international prices experience large increases, which could prove to be as much as by 15-40%.[77] The episode demonstrates the possibility for market disruption, while simultaneously revealing that a shock from a nuclear accident will likely be drastically smaller in relation. In these listed instances, the *entire* country in question was affected by weather conditions. Future accidents are unlikely to have such large geographic reach. As the NEA framework points out, nuclear and radiological accidents will most-likely affect only a discrete and perhaps limited number of export food products from any affected area.

This high yield variability for various agricultural goods produced in these specific regions and countries show the impact on world and regional commodity price volatility, how states have responded to such situations, and the potential for similar outcome following a nuclear or radiological emergency. A decline in overall production as a result of a nuclear accident may not be as large as the decline forced by a country-wide drought, but it could still be considerable. Price changes are closely correlated with the size of the shock, the thinness of the market, and the market integration of different countries. The effects of the example outlined above were identifiable on the global scale, but the impacts were greatest for regional markets. The impact of a nuclear or radiological emergency is likely greatest at the regional level as well. Without more definitive and extensive research, more conclusive inferences cannot be drawn. The specific weight given to a number of other factors cannot be isolated, but the connection is logical and important for situating food safety following a nuclear accident in a greater context.

[74] OECD-FAO (2011), "OECD-FAO Agricultural Outlook 2011-2020", OECD Publishing and FAO. <http://dx.doi.org/10.1787/agr_outlook-2011-en>. P. 55.

[75] Ibid. P. 96.

[76] Ibid. P. 18.

[77] Ibid. P. 20.

PART VII: THE MACRO-DATA OF JAPAN AND TRADE-RELATED MEASURES (COMPILED FROM OECD AND WTO DATA)

Any attempts to develop a viable and realistic framework for food safety and trade following a future nuclear or radiological emergency must be situated in a wider understanding of the macroeconomic context and costs. The Great Earthquake that struck the east coast of Japan in 2011 was one of the costliest disasters in the country's post-war history. The costs of the earthquake were magnified greatly due to the accident that was precipitated at the Japanese Fukushima Daiichi nuclear facilities as a result of the ensuing tsunami. While agriculture has always played a central role in the traditions and culture of Japan, "extending to the very beginnings of recorded history," [78] the accident once more demonstrated the considerable importance that all governments in all countries around the world place on food safety and food security for their respective populations. In the last fifty years, the relative importance of agriculture has fallen in most OECD economies compared to developing countries, but the accident revealed that a nuclear disaster can have considerable effects on a country's ability to trade in agriculture goods and also revealed the consequences a disaster can have on a domestic economy.

Despite the financial collapse of 2008 and the Great Earthquake of 2011, both of which slowed growth and outlook, Japan remains an economic giant and undoubtedly one of the highest standards of living. The country's success is built upon the dynamic growth of its manufacturing, technology, and exports. At the same time, the nuclear accident brought to light that agriculture continues to carry a powerful cultural force in the country today.[79] In today's increasingly globalized community, the import restrictions that Japanese farmers and producers have faced at the border of some of the country's largest trading partners (Table 4), as a result of the accident, are becoming some of the most talked about trade disputes. Japan, for example, has indicated that it will file an official complaint against South Korea at the WTO Dispute Settlement Body over the latter's import ban on various Japanese fish.[80] Disagreements remain, but several countries, including Canada and Chile, were able to lift their initial import restrictions less than one year after the accident.[81]

[78] OECD (2008), *The Evaluation of Agriculture Policy Reforms in Japan*, Paris. P. 11.

[79] Ibid. P. 11.

[80] "Japan to File Complaint to WTO for Korea's Fish Import Ban." *The Korea Herald*. N.p., n.d. 29 Apr. 2014.

[81] WTO Secretariat, Committee on Sanitary and Phytosanitary Measures, Summary of the Meeting of 27-28 June 2012, G/SPS/R/66 (23 May 2012). P. 4.

TABLE 3: Main Japanese imports and exports of agricultural goods (2004-06) [82]

Imports	*JPY million*	%
Pork	1376215	9.6
Maize	903292	6.3
Fresh and dry fruits	696846	4.8
Beef	646546	4.5
Soybean	498374	3.5
Wheat	422648	2.9
Poultry and Poultry Products	335744	2.3
Frozen Vegetables	312751	2.2
Coffee	283211	2
Fresh Vegetables	287119	2
Other	8607518	59.9
Total	14370264	

Exports	*JPY million*	*%*
Confectionary	63640	9.7
Wheat Flour	26092	4
Fresh and dry fruits	20535	3.1
Lemonade, etc.	17610	2.7
Compound feed	16241	2.5
Raw hides of pig	15500	2.4
Instant noodles	9647	1.5
Soy Sauce	9518	1.4
Fresh/dry vegetables	8372	1.3
Green Tea	6863	1
Other	462502	70.4
Total	656521	

Determining the total economic costs of the nuclear accident on Japanese imports and exports would require an additional study, but several indicators reveal the broad dynamics of the Japanese economy in the months and years that followed. As the OECD highlights in its 2013 *Economic Survey of Japan,* the Japanese government launched a ten-year reconstruction programme following the earthquake, tsunami and nuclear accident that focused specifically on the prefectures of Iwate, Miyagi and Fukushima in the Tohoku region. The Japanese Government has indicated that 99.6% of the people killed or missing following the Great Earthquake came from those prefectures. Likewise, 96% of the houses that were destroyed were located in these areas. Japan's economy strongly rebounded late in 2011 from the earthquake, tsunami, and nuclear accident as a result of government action. Not long afterwards, the economy quickly stalled again in mid-2012, "leaving output 2½ per cent below the peak recorded in 2008 prior to the global economic and financial crisis."[83]

[82] OECD (2008), *The Evaluation of Agriculture Policy Reforms in Japan*, Paris.

[83] OECD (2013), *Economic Surveys, Japan*, Paris. P. 13.

TABLE 4: Major Trade Partners (2004-2006)[84]

Imports	%	**Exports**	%
USA	30.9	Chinese Taipei	23.5
EU	13.5	USA	19.1
China	12.8	Hong Kong	14
Australia	9.9	Korea	9.8
Canada	6	China	8.4
Thailand	5.6	EU	6.8
Brazil	3.5	Singapore	3.1
New Zealand	2.5	Thailand	2.9
The Philippines	1.7	Australia	1.6
Indonesia	1.7	Canada	1.3
Other	11.7	Other	9.6

Despite heightened scrutiny of Japanese agriculture goods and an array of import restrictions around the world being put in place, the decline in output, according to the OECD, that was particularly stark in the second and third quarters of 2012, was primarily due to weak external conditions. Exports did fall sharply by 0.5% drop in 2011, the year of the accident,[85] but the drop was a result of Japan's falling production levels and its concentration in capital goods, intermediate goods, and other discretionary consumer products. The drop was not influenced heavily by a decline in traded agriculture goods.[86] The potential regional price effects of an accident that were outlined above were likely muted given that Japan is a large net-importer rather than exporter.

Several other factors also played into Japan’s decline in output. The country’s exports suffered from a strong yen, which in mid-2012 was 45% above its 2007 level in nominal effective terms and 24% in real terms, reflecting capital inflows to Japan, a country which served as a “safe haven” during global financial turbulence.[87] According to the OECD 2013 *Economic Survey of Japan* the yen appreciated by 82% over the course of several years before the accident relative to the Korean won, which is crucial given the competition between Japanese and Korean products in world markets and their dispute at the WTO. [88] It is often said that a currency is overvalued when its exchange rate makes domestic goods expensive relative to similar goods sold abroad. A country’s currency is undervalued in the opposite case. In addition, Japanese exports to China, which account for a quarter of Japan’s total exports, fell particularly fast, reflecting to a large degree the political tension with China that has cropped up in recent years. Finally, the intensification of the euro area crisis contributed to a double-digit fall in Japanese exports to the European Union.[89]

[84] OECD (2008), *The Evaluation of Agriculture Policy Reforms in Japan*, Paris.

[85] World Trade Report 2012. P. 18.

[86] Thorbecke, W. (2012), “Estimating Trade Elasticity’s for World Capital Goods Exports”, *RIETI Discussion Paper Series*, 12-E-067, The Research Institute of Economy, Trade and Industry, Tokyo.

[87] OECD (2013), *Economic Surveys, Japan*, Paris. P. 15.

[88] Ibid. P. 16.

[89] OECD (2013), *Economic Surveys, Japan*, Paris. P. 16.

World Trade Organization Law/SPS Agreement and Notification

Over the last half-century, particularly following several successful rounds of international negotiations, classical barriers to international trade have been greatly reduced. Tariffs have been all but eliminated for some imported goods, but political pressure for domestic protection remains. To that effect, a recent analysis by the United Nations Conference on Trade and Development (UNCTAD) (2012) demonstrated a significant upswing in the domestic use of non-tariff measures (NTM) and an even more significant prevalence of Technical Barriers to Trade (TBT) and Sanitary and Phytosanitary (SPS) measures. To see exactly why the NEA framework has isolated the trade policy responses of countries as an important issue to examine following a nuclear accident, consider that these TBT and SPS measures cover more products and trade value than traditional "hard measures," such as price and quantity control measures.[90]

The effects of the 2011 nuclear accident on trade can be seen in Table 5 by the spike in the number of restrictive NTMs from 30 in 2010 to 81 in 2011. The number of liberalizing NTMs in the same year as the accident fell from 23 to 13. The WTO has attributed the significant increase in restrictive measures, including stricter import controls and licensing requirements, and import prohibitions, to those measures imposed on Japanese goods following the Fukushima accident.

[90] World Trade Report 2012. P. 111.

TABLE 5: Trade and trade-related measures, 2008-2011 (Number of New Measures)[91]

	2009		2010		2011[a]	
	Restrictive	Liberalizing	Restrictive	Liberalizing	Restrictive	Liberalizing
Trade Remedy	**196**	**127**	**132**	**134**	**104**	**118**
Anti-dumping	133	95	97	106	79	107
Countervailing	23	12	11	8	12	6
Safeguards	40	20	24	20	13	5
Border	**117**	**68**	**98**	**145**	**154**	**137**
Tariff	57	43	61	122	66	124
Tax	0	0	7	0	7	0
Non-tariff barrier[b]	60	25	30	23	81	13
Export	**13**	**10**	**47**	**19**	**66**	**35**
Duty	4	6	19	3	15	7
Quota	0	0	3	3	12	6
Ban	1	1	14	9	23	14
Other	8	3	11	4	16	8
Other	**20**	**12**	**29**	**25**	**20**	**14**
Total	**346**	**217**	**306**	**323**	**344**	**304**

[a] Up to mid-October 2011.
[b] Excluding SPS and TBT measures.

The table above shows the notable magnitude of the restrictions facing Japanese exports, but even this detailed table cannot provide the complete picture because the specific import controls and licensing requirements included in this WTO calculation for Japanese goods following the Fukushima nuclear accident do not include all the TBT or SPS measures that were erected. The table can thus only serve as a sample of sorts. For the most restrictive measures permissible under WTO law, the SPS measures, only thirteen countries formally reported to the WTO (Table 6). The NEA framework identifies that many trade restrictions will likely emerge following an accident until greater information can be gathered. As outlined previously, in parallel with the NEA framework, many of the import restrictions that were initially erected were withdrawn within one year of the accident.

[91] OECD (2013), *Economic Surveys, Japan*, Paris. P. 121.

TABLE 6: SPS Emergency Measures Related to Japan Notified to WTO[92]

Member imposing	Imposing Country Product Description	Initiated (First Raised)	In Force (Last Raised)	Avg. Bound	Avg. MFN
Australia	Seaweed, fresh and frozen seafood (excluding fish based pastes and sauces), milk and milk products and fresh fruit and vegetables	14-Apr-11	12-Apr-11	1.9	0.5
Bahrain	All food items, except otherwise accompanied with an official certificate of normal radiation levels	18-Jul-11	07-Apr-11	32.6	4.4
Brazil	Food and food products	14-Apr-11	01-Apr-11	29.8	11.6
Brunei Darussalam	Fresh agricultural and fish products; processed foods	09-May-11	29-Mar-11	24.7	3.3
Chile	Cereals, roots, tubers, vegetables, fruit, meat and meat products, milk and milk products, fish and shellfish and products thereof, and baby and infant foods.	15-Jun-11	03-Jun-11	25.1	6
Colombia	Animal feed and food for human consumption	13-Sep-11	-	42.9	8.6
European Union	Feed and food from certain regions of Japan.	01-Apr-11	27-Mar-11	4.5	4.8
	Feed and food from certain regions of Japan	11-Apr-12	01-Apr-12	4.5	4.8
Korea, Republic of South	Imported fish, bivalves, molluscs and algae from Japan	16-Sep-13	-	-	16.5
	Feed	20-Nov-13	-	-	19.5
Oman	Fresh/processed food and animal feed	04-Apr-11	27-Mar-11	13.3	4.4
Philippines	Fish and Fishery Products (HS Chapter 03 and HS Code 1604)	11-May-11	29-Mar-11	-	8.8
	Meat, dairy products, live animals, and animal feed products	11-May-11	24-Mar-11	25.6	6.8
	Plants, Planting Materials, and Plant products (HS Codes 06, 07, 08, 09, 10, 17, and 24)	18-Jul-11	18-Apr-11	39	12.7
Saudi Arabia	Fresh and processed food from certain regions of Japan	28-Apr-11	16-Apr-11	-	4.4
Chinese Taipei	All imported food items produced in the Fukushima, Ibaraki, Tochigi, Gunma and Chiba prefectures of Japan.	30-May-11	26-Mar-11	6.3	6.0
Thailand	Import requirement for food with risk from radionuclide contamination (ICS Code 67.040)	28-Apr-11	12-Apr-11	-	10.4

92 http://i-tip.wto.org/goods/Default.aspx

The importance of solving misconceptions and trade frictions around the globe is clear. The SPS Agreement and its reference to the Codex Alimentarius standards serves as the principle legal framework for the assurance of radiation food safety for imports around the globe, and many of these trade developments have been witnessed before following other food safety cases. Unsurprisingly, trade concerns related to SPS measures overwhelmingly affect the agricultural sector (almost 94%), and no disputes involving non-agricultural products cited the SPS Agreement. [93]As the OECD highlights in its 2013 *Economic Survey of Japan*, economic growth in the prefectures of Iwate, Miyagi and Fukushima in the Tohoku region, the three most affected prefectures, had lagged behind the Japanese national rate. Before the accident, the gap in per capita income in the three prefectures, for example, widened from 12% below the national average in FY 2000 to 14% below in FY 2008.[94] According to the Basic Guidelines for Reconstruction, agriculture, along with the forestry and fisheries markets, "constitutes the key industry of Tohoku and plays a significant role for local employment."[95]

The microeconomic and trade indicators for the most effected prefectures in Japan would provide the most detailed and relevant information related to the costs of the accident and the impact of various trade policies. As other food safety incidents have demonstrated, and as outlined above, entire countries or products can suffer in international trade markets as a result of informational asymmetries, reputational consequences and suppressed demand. It is likely that all Japanese exports have suffered to some degree from suppressed demand as a result of originating from a country that recently experienced a nuclear accident. To determine the statistical significance of the drops in volumes of trade across different years for Japan, a more detailed econometric model would be required and a more detailed aggregation of import restrictions would need to be compiled. Nevertheless, the information above provides an important and broad outline to understanding more clearly the development of the NEA framework.

[93] World Trade Report 2012. P. 8.

[94] OECD (2013), *Economic Surveys, Japan*, Paris. P. 63.

[95] Ibid. P. 63.

SECTION IV: CONCLUSION

The 2013 EGRPF Sub-Group on Trade in Commodities and Food agreed that its objective was to develop a framework approach that could be used for moving forward in the development of trade criteria for food, consumer products, and commodities, and that other organisations would be able to build and develop international agreements from it in this area. The framework approach has proven to be productive, eliciting new lines of thinking, queries, and conversation among interested parties and governments. This report and outline of the NEA framework recognizes that any development in this area will require the action of international organizations and the very explicit participation of relevant member bodies.

While the process of developing a framework remains on-going, and the NEA fully anticipates that its framework will continue to develop and grow, the foundation here outlined can serve as an extremely strong starting point for the response to any future accident. To bolster the framework further and to refine accident preparedness, other critical questions could be addressed with future research. Understanding consumer responses to various food safety issues, for example, including a post-nuclear disaster scenario, is of critical importance if effective food safety policy and risk communication strategies are to be developed and implemented in the future. Previous food safety experiences have demonstrated that drastic policy changes can at times do little to assuage consumers of their concerns for safety, and policy changes can even often even exacerbate consumer concerns. Future research could attempt to shed a greater light on the reputational effects associated with traded food will become clear.

In addition, while the current international mechanisms and framework collectively make-up a solid foundation and utilizing them is important, within the international context for food safety and international trade that was outlined above, it can be understood that the necessary levels of familiarity and trust in trade, most importantly for food safety, radiation protection, and trade following a nuclear accident, can always be further developed. Improving the understanding of radiation effects and food safety for all stakeholders is vital to quick and effective management in the event of a future accident. By consequence, other future research in this area could attempt to find areas for greater capacity building, which could help to address concerns regarding both the unease of consumers in importing countries and the differences in SPS regulatory measures and capabilities, which could additionally reduce trade frictions following a nuclear or radiological emergency in the future.

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