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Environmental Risk Perception in the Aftermath of the Great East Japan Earthquake/Nuclear Disaster and Its Socioeconomic Status Background From the Perspective of "Environmental Risk Democracy"

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abstract

Significant transformations to the value system in Japan in the aftermath of the Great East Japan Earthquake/Nuclear Disaster include a distrust in the evaluation of environmental risks by scientists and experts, with an increasing tendency towards "environmental risk democracy," in which citizens participate in the related decision processes. Environmental risks were divided into three types—known "probabilistic risk," unexplained "uncertain risk," and unknown "catastrophic/irreversible risk"—in order to analyze participatory democratic trends in the construction of environmental risk discourse, including differences in cognition and avoidance behaviors, in access to informational/economic resources necessary for evasive behavior, in "post-materialism" environmentally friendly behavior, and in awareness of "environmental justice" problematization which are attributable to social strata. The upper stratum is active in behaviors such as radioactive contamination avoidance, but shows relatively strong confidence in science and experts. The lower stratum perceives environmental risks as more serious, but lacks actionable resources. Due to the ambivalent situation of both, it is difficult to derive citizen participation orientation ("environmental risk democracy" orientation) towards risk assessment and decision-making processes from social stratification, suggesting the necessity of the introduction of mediating variables such as social distrust and dissatisfaction.

Key Words: environmental risks, risk society, risk democracy, environmental justice, post-materialism

1. Introduction

1.1 Delays to Environmental Risk Theory in Japan

Ulrich Beck's *Risk Society* (translated in Japan as "危険社会" (*Kiken Shakai*), 1986=1998), written on the occasion of the 1986 Chernobyl nuclear disaster, was the first time that environmental risk was considered from a sociological perspective. In the beginning of the book, Beck describes a risk society as a "society in which risk production, distribution, and definition becomes problematic"; these characteristics are contrasted with the reality of an industrial society, in which "production and distribution of wealth" con-

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tinue to be the biggest problems (Beck, 1986=1998, 23).

Although the issues raised by Beck in *Risk Society* can be considered meaningful in their comparison of class society and mass society in contemporary sociological theory, subsequent development of the risk society theory in sociology in general has included discussion of social (sociological) issues such as "second modernization," "reflexive sociology," and "individualization," rather than environmental risk. The motifs in *Risk Society*—which was written in the aftermath of the Chernobyl nuclear fallout that came from Ukraine and created hot spots throughout Europe—include the core concepts of "environmental risk." However, as the definition of environmental risk is a difficult theme for sociology, it was not investigated further.

There is no definition for the "production and distribution of wealth" that regulates industrial society. This is perhaps because the definition of "wealth" itself is widely understood and not necessary. Of course, the form "wealth" takes, whether money, land, precious metals, intellectual property rights, or the like, can be replaced with a monetary value by the market in any case. On the other hand, the way people experience "risk" varies. Nonetheless, the perception of the seriousness of "social risk," such as divorce or unemployment, is largely shared by society. However, according to Beck, when it comes to "environmental risk," dependency on scientific analysis is even higher. In the case of harmful substances, sociologists (social scientists) are often confronted with a stream of natural-science terms such as "maximum no-observed-adverse-effect-level (threshold)" or "median lethal dose."

Of course, social scientists are not without opportunities. Since the beginning, many social scientists have raised objections to rhetoric used to persuade citizens to accept the risk by referencing the "safety" (low accident probability) of nuclear power plants and Japan's energy crisis due to lack of energy resources (for example, Murota, 1986). They have also criticized the expert dominance structure (e.g., Yoshioka, 2011) in which the risk assessment entity and the beneficiary subject have been combined. With the definition of "environmental risk" almost entirely monopolized by "experts/scientists," and the construction of nuclear plants and expansion of genetically modified organisms (GMOs) promoted by bureaucratic state organizations and gigantic multinational companies, it could be said that one of the most tragic consequences of the lack of a publicly accepted "definition of environmental risk" was the Fukushima Daiichi Nuclear Disaster.

For those of us who experienced the great turmoil of the March 11, 2011, earthquake/nuclear disaster, how a contemporary society defines, evaluates, and selects unprecedented environmental risk within public discourse is a practical theme of risk society theory in environmental sociology. At the risk of using words that have not yet fully matured, there is a problem with awareness of the term "risk democracy."

While well suited to a post-March 11 theme in that sense, the following plan to develop a survey on risk consciousness and the problem of awareness was conceived of by the author long before the events of March 11.

Its origins date back to 1983, when I first interviewed members of overseas environmental movement organizations. Although I had already heard about British and French environmental groups such as Friends of the Earth and the various Green Parties, on that occasion their efforts regarding dioxins and asbestos were particularly impressive. In Europe in the 1980s, the idea had begun to spread of a "precautionary principle," a regulation in response to environmental risk in the case of reasonable probability, even if a scientific causal relationship was not confirmed. This idea arose in response to problems such as the depletion of the ozone layer and chemical pollution in the North Sea. The stance of the environmental movement in preparing for environmental risks was becoming clearer. By contrast, the Japanese environmental movement situation, while inevitable given its historical background, still had a long way to go. Movements concerning certification and compensation for victims of industrial pollution accounted for a considerable portion of the movement, while preventive measures against problems such as damage to health have not yet been actualized.

While I was also greatly inspired by what I felt was the next step in the Japanese environmental move-

ment, in all honesty, I did not have a serious concrete prediction for the amount of damage caused by asbestos and other such materials at that time.

However, regulations on the use of asbestos and dioxin emission at garbage incineration sites, which had already been implemented in the 1980s in Europe and the United States, were neglected or significantly delayed in Japan. The legacy of these two environmental risks became a significant social problem stemming from the late 1990s into the early years of the 21st century. I was ashamed that I could not make use of my own obscured research findings from the 1980s. In Japan, a latecomer to industrialization and the environmental movement, policy-makers and environmental movements alike are relatively earnest in regard to the damage caused and its compensation. However, they seem less interested than their counterparts in Europe and the United States in potential environmental risks whose damage has not yet become apparent.

Because of the leading cost burden for future environmental damage in preventative measures against environmental risks, it is necessary that a "problem framing" be built socially, regarding the potential severity of the damage, and who it may affect. This is the problem of consciousness introduced in Hannigan's"social constructivist environmental sociology"(Hannigan 1995=2007). Since the late 1990s, I have largely been influenced by the environmental justice movement (an anti-environmental-racism movement in the United States) and has analyzed the process of building a "problem framing" for environmental risks with regard to Japan's industrial waste disposal site problem and the regional disparity between urban cities and rural towns. The process of building a "problem framing" for environmental risks has been examined in case studies (Terada, 1998, 2001). Furthermore, in concurrence with such case studies, I wanted to conduct a quantitative awareness survey on environmental risk cognition.

1.2 "Natural Scientific" Environmental Risk Theory and "Social Constructivist" Environmental Risk Theory

In general, environmental risks in natural science are calculated as values obtained by multiplying the hazard (hazard: the severity of damage/inherent harmfulness of a substance) by the probability of accident occurrence (probability) or frequency of exposure (exposure). In a formula, it is expressed as R (risk) = H (hazard) × P (probability).

For example, the mortality rate of a plane accident is high, but the probability of the accident occurring is small; therefore, an airplane is evaluated as being a relatively safe vehicle. In the case of lethal carcinogenicity (hazard), by limiting the intake amount and exposure amount to 1 kilogram of body weight or less per day, it is possible to limit the carcinogenic rate to one person or less per 100,000 people. In this way it is possible to objectively evaluate the size of the hazard itself, the probability of occurrence, and the extent to which the damage occurs quantitatively.

Furthermore, by taking into account the cost of countermeasures, it will be possible to create a policy priority ranking system for more economically effective risk reduction.

A more detailed discussion is covered in a separate paper (Terada, 2011), but at least two problems can be pointed out regarding the social meaning of natural science environmental risk theory. The first is the problem of non-experts with poor "risk literacy," who do not truly understand the idea of risk. Often, "irrational citizens" in civic/environmental movements demand a "zero risk" policy, creating a problem diagram of conflict between the "objective, theoretical, rational" experts and the "subjective, emotional, irrational" non-experts/citizens.

Described by Terada (2011), for example, according to Junko Nakanishi (2004b: 33–34): "In Europe and Japan, due to a strong belief in the idea that administrative organizations should ensure absolute safety, there must be zero possibility of risk [quote on citizens]… it is impossible for risk to be accepted according to these conditions; unless [they] are in position to accept risk, risk assessment as it exists cannot emerge [quote on government agencies claiming that risk is zero as is]." Nakanishi's intention, from the

position of environmental chemists attempting to reduce the risk in total, is to caution citizens calling for an impossible zero risk due to distrust for the administration to proceed with more rational and reasonable risk discussion. This is an example of the typical natural scientist's impression of the irrational citizens and natural scientists in the environmental movement, who demand zero risk to the very end without taking factors such as cost and feasibility into account.

Schrader-Frechette (1991=2007) criticizes the position of natural scientists who emphasize risks with an "objective numerical value" as "naive positivism," while also pointing out that risk has aspects which are socially constructed. For example, the end point of environmental risk is often considered to be the human mortality rate, but taking a wider perspective, the end point could be the risk of biodiversity reduction or the extinction of threatened species. Although greater attention regarding the safety of GMOs and their effects on the human body has been gained, little attention has been drawn to the risks associated with the diffusion of artificially modified genes (such as herbicide-tolerant genes) and the like into the environment, which leads to irreversible pollution and disturbance to ecological genetic information. Although it is impossible to compare the death of an individual person and irreversible changes to the environment with the same scale, it is possible to construct an environmental risk that emphasizes the latter as the end point.

Furthermore, taking into account personal value preference factors, there may be a difference in the weight or meaning of risk, as in "even if death from a traffic accident can't be helped, it is unacceptable to die due to a nuclear accident." How "environmental risks" are "socially constructed" or perceived depends to a large extent on the given society's culture and value system. Risk assessment is influenced by individual values, not only for the general public but also for experts and scientists, although to a different degree.

However, even though environmental risks are constructed differently depending on culture and values, it is still undeniable that environmental risks have an "objective, scientific numerical value" aspect as well. If we try to reduce it to a mere value preference or social construction, naive positivism lapses into its opposite, "cultural relativism." Schrader-Frechette's goal is to explore the middle of the spectrum.

The second problem is that the experts/scientists of environmental risk theory frequently introduce new technologies. Often, they are used for rhetoric or political ideology to encourage citizens to accept the frequent introduction of new technologies. Additionally, there is a significant gap in access to information on environmental risk and analysis ability between experts/scientists and lay citizens. Furthermore, experts often act with the interests of administrative organizations and business corporations in mind. The "nuclear safety myth" is a particularly notable example. From the planning stage, ordinary citizens, especially residents of the site of the nuclear power plant, were repeatedly urged to accept construction based on explanations of the "high degree of safety" provided by multiple levels of protection. This also applies to the spread of GMOs and the like.[1]

There is also an enlightening natural scientific environmental risk theory from the view of advancing "more rational" water quality improvement measures advanced by conscientious environmental chemists, such as Nakanishi. In any case, however, the original "scientific and objective" assessment of environmental risks is made more accurately by scientists. Still, as the irrational, emotional environmental risk perception of non-expert citizens requires correction by scientists, it is undeniable that both groups recognize an asymmetry/inequality.

1.3 Social Psychological Risk Cognition Research and the Environmental Sociological Perspective

A series of social psychology risk cognition studies has attempted to elucidate the difference in risk perception between experts/scientists and general citizens through psychological cognitive structural analysis. For example, Slovic (1987) analyzes the different characteristics between acceptable risks by the public

and inacceptable ones. People are more likely to accept risks of one's own intention, expected profit risks, well-known risks, and risks they believe are controllable. On the contrary, risks imposed against one's own intentions, risks that feel scary, risks that have never been experienced before, and risks with uncertainties are easy to avoid. Cognition also depends on how risks are communicated. The perception of risk changes depending on the way it is expressed: consider, for example, "the probability of survival is 70%" versus "the probability of death is 30%" (Nakayachi, 2003).

These social psychological risk cognitive analyses are like studies of optical illusions, where straight lines that appear to have the same length or parallel angles are incorrectly perceived due to the straight lines that surround them. Even if risk is originally evaluated objectively, differences in general human characteristics have been researched that indicate that they may become easier or more difficult to accept emotionally (in this sense, irrationally) depending on whether they are known or unknown, or if individuals have made the decision themselves. While the study itself is neutral, it can also be used to make risk appear to be less than it actually is in order to encourage acceptance, while opposition movements may use it to emphasize the risks. Of course, it can also be used to communicate risk accurately, as in the purpose of this original research.

Although these studies are rich in suggestion, for us specializing in environmental sociology, I cannot help but think that it is inevitable that the *habitual cognition and bias of humans in general* lead to limitation in parts of this research. Though there are categories for analysis such as expert/non-expert and gender, for *social actors with different socioeconomic positions and attributes, analysis of sociological environmental risk cognition in terms of how risks carry different meaning* cannot be directly found in them.

In the analysis of environmental sociology environmental risks, it is necessary to clarify the meaning of risk according to the social position, individual stratum attribution, group attribution, interests, value systems, communication and so on of the individual actors, rather than risk recognition for humanity in general. First of all, as detailed in Terada (2011), in addition to "probabilistic environmental risks" expressed as $R = H \times P$, it is necessary to consider the social problem inherent in "uncertain environmental risks" and "irreversible/catastrophic environmental risks," where probabilistic calculation is difficult. In addition to the general perception of virtual risks, analysis at the behavioral level, such as what risk avoidance behaviors people exhibit, was also included, given the specific circumstances such as avoidance of radiation risk after the Fukushima Daiichi Nuclear Disaster.

2. Outline of Risk Consciousness Survey and Hypothetical Group

2.1 Survey Background and Overview

A risk consciousness survey targeted toward citizens in the form of a questionnaire was conceived of in 2010; a Grant in Aid for Scientific Research (B) was applied for and approved. In March 2011, as the preliminary study group session was about to be held, an odd combination of earthquake and nuclear disaster became a reality.

Theoretical hypothesis and research planning began in 2011, initially raising the problem of risk cognition and its social background, particularly social justice cognition and distribution of environmental risks, with a theoretical hypothesis focused on Beck's question of "environmental risk definition" set to be constructed before the disaster occurred. For the sake of environmental risk research, tasks were added in response to the occurrence of this serious incident, and a new question group was created, including responses to radiation contamination after the disaster, risk avoidance behavior, and renewable energy policy opinions.

Furthermore, one of the collaborators for this research, Professor Hiraoka of Shizuoka University, based on a survey conducted in collaboration with the *Chunichi Shimbun* (a Tokyo newspaper) in January 2012, added a question group for community participation and social confidence, in addition to the attrib-

uted social stratum.

In fiscal year 2012, a working hypothesis was advanced and a questionnaire was prepared. Survey sites included were Kawasaki City in Kanagawa Prefecture and Mito City in Ibaraki Prefecture. The reason these cities were selected, despite being located in the Kanto area where damage from the earthquake/nuclear disaster was mild to moderate, is that Mito City is located about 125 km away from the Fukushima Daiichi Nuclear Power Plant, and Kawasaki city is located about twice as far, 250 km away. It was believed that a difference in crisis cognition with regards to radioactive contamination from the nuclear disaster could be discovered.

From December 2012 to January 2013, 2,000 survey samples from Kawasaki and Mito, respectively, were chosen; a total of 4,000 respondents were randomly sampled. The survey was mailed at the end of January 2013, and from February to March, 1,303 responses (including 593 responses from Kawasaki and 710 responses from Mito) were collected. With a population of 3,946 responses, excluding responses from unknown addresses, the collection rate is 33.0%. The sample error of 1,303 samples is ± 2.77 points, with a 50%/50% distribution.

2.2 Three Types of Environmental Risk

While the primary subjects of research of this survey can be succinctly summarized as "environmental risk" and "social justice," due to its collaborative nature, it has considerable breadth. If mentioned, primary factors for avoiding radioactive contamination risk (such as residual radiation in food) include access to information sources on environmental risks, health, food risk (general), nuclear policy/renewable energy policy, experts and citizen involvement in policy making, type of environmental risk, environmental conservation awareness and behavior, social confidence, and risk perception. In this paper, two points in particular are developed: how the type of environmental risk relates to socio-economic status, and how it influences risk consciousness.

First, the types of environmental risk are shown in Table 1 (for details, see Terada, 2011). As mentioned in the previous section, environmental risk is usually calculated as the hazard (the severity of the damage/degree of harmfulness) multiplied by the probability of occurrence/exposure frequency. However, while this is applicable overall, it is inherently limited to known sources of environmental risk, which are already scientifically understood, such as heavy metals and sulfur oxides. I would like to call these kinds of "known environmental risks" the first kind of environmental risk, or "probabilistic environmental risks."

Known "probabilistic environmental risks" are often points of environmental dispute in a region, such as automobile exhaust gas, water pollution, waste problems, and other issues that are well-known environmental risks for citizens but which no longer attract mass media attention. Moreover, as in the "Minamata Convention" signed in October 2013 which regulated the export of redundant mercury, these risks are often passed on from developed countries to developing countries and from urban areas to depopulated areas.

It is also well known that "probabilistic risk" has been a point of dispute for environmental justice movements such as the "anti-environmental-racism" movement among Americans of color (Bullard and Wright, 1992=1993), which have been expanding since the late 1980s. As the existence of probabilistic risk and its distribution are relatively clearly understood, it can be said to fit easily into the "environmental (in)justice" standard problem framing, such as if the distribution of risk depends on discrimination or disparity.

On the other hand, it is hard to confirm scientific findings such as the hazard (for example, what kind of damage) and exposure level with regard to risk sources whose damage mechanism remains scientifically unknown (such as endocrine disruptors); the calculation of risk is inevitably subject to error.[2] I would like to call these kinds of environmental risks the second kind of environmental risk, or "uncertain envi-

ronmental risks." As for "uncertain environmental risks," because the actual conditions are not yet fully understood, rather than the justice of the distribution itself, adoption of "precautionary principal" in taking advance regulatory measures becomes an issue, even if information disclosure on the identity of the hazard and scientific causation are not completely elucidated. Specific examples include the "Pollutant Release and Transfer Registers (PRTR) System," an information disclosure system for harmful substance sources, and the "REACH Regulation," an EU management policy regarding chemical substances (Terada, 2008).

The third type of environmental risk is "irreversible/catastrophic environmental risk" (unknown risk). The probability of occurrence for a nuclear power plant disaster, or the damage and probability of a recombinant gene leakage accident into the environment are almost impossible to calculate accurately, because it is impossible in theory to verify through experimentation, due to the irreversible process and the severity of the results. Often, these risk calculations involve multiplying the local hazard by a minimal probability (although this was revealed to be too optimistic after the Fukushima disaster). In other words, the calculation multiplies zero to infinity, and as a result, reliability is markedly reduced.

As it became necessary to face after March 11, along with such "unknowns," the damage incurred by this type of accident is an irreversible catastrophic environmental change and damage to health, quite different from conventional environmental damage, including rendering contaminated areas uninhabitable for hundreds of years and causing unpredictable health risks and lifelong health concerns for countless people. Of course it is difficult to calculate a probabilistically accurate risk, but even if that risk could be calculated, a nuclear accident would cause damage that cannot be repaired within a person's lifetime, and which requires careful ethical consideration. Even without accidents, this technology was fundamentally fraught with environmental injustice issues, including the necessary exposure to radiation of people routinely working inside the reactor, and uranium mining and nuclear waste disposal sites that impose a nuclear waste risk on future generations (at present, the issue is the restarting of existing nuclear power plants). Therefore, social issues concerning "irreversible/catastrophic environmental risk" (unknown risk) are primarily controversies over the adoption and formation of public opinion.

Existing environmental risks theory, however, should not return to the probabilistic cost/benefit comparison, as it is difficult to calculate probabilistic risk without overlooking the qualitative difference between these three types of environmental risks. "Uncertain environmental risk" and "irreversible/catastrophic environmental risks" have been in many cases, I would argue, treated equally in line with probabilistic environmental risks.

Table 1. Types of Environmental Risks (from Terada 2011, partially modified)

	Type 1: Probabilistic environmental risk (known risk)	Type 2: Uncertain environmental risk (unresolved risk)	Type 3: Irreversible/catastrophic environmental risk (unknown risk)
Environmental risk examples	Health hazards of known chemical substances, acute toxicity, carcinogenicity	Pesticides, POPs, endocrine disruption chemicals, electromagnetic waves	Genetic recombination technology, nuclear disaster, nanotechnology, species extinction
Probability of occurrence	Known	Uncertain	Unknown
Occurrence mechanism	Nearly clarified	Some remaining scientific uncertainty	Significant portions unknown
Foreseeability	Significant	Moderate	Low to very low
Avoidance, transfer feasibility	Significant	Moderate	Moderate to low
Catastrophic probability (characteristics)	Low to moderate	Low to moderate	Maximum
Quality of environmental destruction (quantitative - qualitative)	Primarily quantitative	Genotoxicity, persistence of difficult to decompose substances including quality aspects	Genetic information pollution, artificial radioactivity, significant, irreversible, qualitative environmental pollution, etc.

Constructivism issue (Hannigan)	Policy creation (environmental justice framing)	legitimatization of claims ⇒ policy creation (precautionary principle framing)	Identification of problem ⇒ legitimatization of claims
Engaged social strata	Lower stratum (concern regarding risk bias distribution)	Middle/upper strata (information access resources, etc.)	Middle/upper strata (information access resources, etc.)
Environmental policy issues	Primarily direct laws and regulations (pollution control laws)	Information disclosure, comprehensive management (PRTR law, REACH regulation)	Formation of public opinion by participatory/controversial democracy

2.3 Types of Environmental Risk and "Environmental Justice" Hypothesis, "Post-Materialism" Hypothesis

Of the above three types of risks, known "probabilistic environmental risks," and other "uncertain environmental risks"/"irreversible/catastrophic risks," well-known probabilistic risks such as air pollutants and heavy metals, whose risk distribution is relatively widely recognized, seem to show more affinity with the "environmental justice" problem framing (Bullard and Wright, 1992=1993), in which distribution (in) justice is regarded as a problem. For American people of color and low-income communities, who are more at risk for hazardous waste, Bullard and Wright (1992=1993) analyzed the processes by which the "environmental racism" framing was constructed, with regards to the unequal distribution of environmental burden based on race. While racial factors do not manifest themselves in Japan, it is generally expected that people interested in "environmental justice" are from the low-income, lower strata of social stratification.

As for endocrine disruptor and nuclear power plant risks, which are still unknown and unclear, the problems themselves have been identified and confirmed. Thus, in order to be conscious of these risks, a relatively high environmental interest and environmental risk literacy are necessary. accordingly, it is supposed that there is a stronger interest in uncertain environmental risks and irreversible/catastrophic risks among the highly educated, middle, and upper strata of social stratification, which have stronger informational access resources and "post-materialism values."(3)

In summary, our hypotheses should be as follows: For known probabilistic risks, an environmental justice hypothesis would be set up, where disproportionate distribution of risk is problematized primarily among the lower strata of the social hierarchy. For uncertain risk or irreversible/catastrophic risk, which requires higher environmental concern and environmental behavior characteristic of post-materialism, a post-materialism hypothesis is examined. In this hypothesis, the correlation between higher concern for uncertain risk or irreversible/catastrophic risk and the middle and upper strata of the social hierarchy is expected. Furthermore, with respect to the evaluation of "uncertain risks" and "catastrophe risks," it is predicted that risk democracy orientation (citizens who desire to seek participation opportunities) will be more prominent in higher strata with literacy and information access resources.

Table 2. Recognition of the "Irreversibility of Effects" and "Disproportionate Risk Distribution" for Environmental Risks (%)

	When an accident or pollution occurs, it has irreversible effects			Some regions/people are more susceptible to danger and hardship	
	Agree	Somewhat Agree		Agree	Somewhat Agree
A. Nuclear power plants (radioactive contamination)	85.7	10.5		69.1	18.5
B. Genetically modified organisms	32.4	37.7		10.4	19.7
C. Petroleum and coal consumption (global warming)	37.5	37.1		12.4	19.3
D. Synthetic chemical substances	30.7	41.8		13.0	22.6
E. Automobiles (exhaust gas pollution)	20.0	45.3		16.0	30.9

F. Pesticides	28.5	43.3		14.7	24.7
G. Food additive development	18.6	40.7		8.4	15.7
H. Garbage incineration	16.1	39.7		22.3	33.2

3. Cognition and Socioeconomic Attributes of the Three Types of Environmental Risks

3.1 Cognition of the Three Types of Environmental Risk

For each environmental risk item, subjects were asked which of the above three types of risk they would recognize; results are indicated in Table 2. This section will explain the relationship between the irreversible effects of eight items: nuclear power generation (radioactive contamination), genetically modified organisms (GMOs), synthetic chemical substances, automobiles (exhaust gas pollution), pesticides, food additives, consumption of oil and coal (global warming), and garbage incineration, as well as the results of inquiry into the influence of regional or personal bias.

First, nuclear power was an outlier in terms of "irreversibility" (85.7%—hereinafter, figures in parentheses are percentages unless otherwise stated) and "bias" (69.1), obtaining a high "agree" response. This was followed by responses to global warming (37.5), GMOs (32.4), and synthetic chemical substances (30.7). In inquiring into the extent of "irreversible processes," although direct questions regarding scientific uncertainty were not included, among the risks listed, it is inferred that nuclear power is a typical example of "irreversible/catastrophic risk," with global warming, GMOs, and synthetic chemical substances recognized as being similar to "uncertain risk."

On the other hand, risks such as automobile exhaust gas pollution, pesticides, food additives, and garbage incineration, where respondents are in the 20% range or less in believing the effects are clearly irreversible, are reasonably assumed to be similar to known "probabilistic risks." Furthermore, in the case of these items, it can be seen that, with the exception of food additives, responses to "regional/human disproportionate influence" included on the right side of the table are also relatively high. As cognition and the "distribution of influences and risks" are easy to observe, as in air pollution along main roads and industrial areas, it can also be said to be an issue of unequal distribution risk (environmental justice frame).

Table 3. The Irreversible Effects of Environmental Risks: As Seen by the Attribute "Agree"/"Somewhat Agree" (%)

		Nuclear power plants (radioactivity)	Genetically modified organisms	Global warming	Synthetic chemical substances	Automobile exhaust gas pollution	Pesticides	Food additives	Garbage incineration
Gender	male N=680	84.2/12.4	33.3/35.6	35.7/37.6	29.8/41.3	18.1/44.8	26.3/46.0	18.1/20.1	11.9/38.7
	female N=620	88.8/9.1	32.7/**41.4** **	**40.8/48.2** ***	**31.6/45.0** *	**22.6/45.4** *	**32.1**/42.2 *	**20.1/41.7**	**21.5/42.1** ***
Age	20 to 49 N=567	85.9/11.7	28.5/37.7	40.3/37.6	29.0/43.6	16.8/43.3	23.9/43.3	12.3/36.8	15.8/39.5
	50 and older N=730	86.7/10.2	**36.4/39.2** **	36.4/37.8	33.3/42.8	**22.7/46.6** **	**33.2/44.9** ***	**24.5/45.5** ***	16.9/41.2
Education	high school degree or less N=498	85.1/11.2	31.0/39.2	37.8/37.1	31.5/41.4	**24.1**/44.1	**32.6**/43.0	**20.5/43.3**	17.1/41.6
	undergraduate degree or more N=795	87.1/10.6	34.3/37.7	38.1/38.1	31.5/44.0	17.7/45.7	26.6/44.9 *	18.0/40.6 ***	15.9/39.3

Income	over 8 million yen N=269	87.0/10.4	32.8/37.7	39.6/16.0	28.3/46.0	15.4/43.8	26.2/40.4	17.5/38.1	12.4/41.2
	between 4 million and 8 million yen N=491	89.0/9.0	**35.9**/37.5	37.7/40.4	32.4/44.9	16.7/48.7	27.2/46.3	17.3/43.7	15.8/43.6
	less than 4 million yen N=515	83.7/12.9	29.9/39.5 *	39.4/34.1	31.8/40.1	**26.0**/41.7 **	**31.9**/44.7 *	**21.1**/41.9	**18.1**/37.3
Status identification	upper class, upper middle class N=400	86.9/9.8	34.1/36.4	33.6/41.9	32.2/41.6	14.5/45.8	27.0/41.7	16.5/41.8	11.2/41.9
	lower middle class N=603	87.0/10.5	31.9/41.0	**40.4**/37.7	30.8/44.1	**22.6**/45.5	30.1/45.8	**20.1**/43.3	**18.8**/42.3
	upper/ lower lower class N=279	83.8/13.4	32.7/36.0	**39.2**/31.9	31.0/43.5	**22.2**/44.1 *	29.0/44.5	**20.0**/38.1	**17.9**/32.8 *
	Total	86.3/10.9	32.8/38.5	38.0/37.8	31.3/43.2	20.0/45.3	28.9/44.2	18.9/41.7	16.2/40.1

(X square significance level: * P. < .05, ** P. < .01, *** P. < .001)

3.2 Socioeconomic Attributes and Risk Perception

Table 3 shows the percentages for "agree" and "somewhat agree" responses by attribute for the irreversible effect of each environmental risk item.

It shows that by gender, women are more likely than men, and by age group, middle-aged and elderly people are more likely than young people, to display serious awareness, a tendency which is very common in environmental consciousness surveys. In further detail, women displayed more serious cognition than men in almost all items, while items in which middle-aged and older subjects were more seriously aware of influence in comparison with younger generations included "traditional" high-growth environmental problems such as "automobile exhaust gas pollution," "pesticides," and "food additives." Generational experience can be seen in those over 50 years old, who experienced firsthand a time when these environmental problems were considered major social problems.

Looking at other attributes, in general, it is understood that risks are more seriously recognized among the less educated, lower-income stratum than in the higher educated, high-income upper/upper middle strata of social stratification. However, with regard to academic background, although there is an influence of pseudo-correlation caused by the relatively few number of college graduates among women and older respondents, even if age and gender are controlled for, the university graduate group shows no particularly high values, and similar or slightly higher values are seen in the "high school degree or less" group.[(4)]

On the other hand, there are many notable items with significant differences in relation to social stratification, and stratum identification in particular. By item, the lower middle stratum and lower stratum are more focused on risks such as automobile exhaust gas pollution, pesticides, food additives, and garbage incineration and are understood to have a relatively serious awareness of conventionally known risks. As will be described later, the lower strata consistently perceive these conventionally known environmental risks more seriously, a finding that supports the environmental justice hypothesis. On the other hand, although the findings for upper strata (upper, upper middle) are somewhat higher in regard to GMOs and synthetic chemical substances, there is almost no difference in seriousness of cognition between irrevers-

ible risks and uncertain risks.

This tendency is more clearly seen according to stratum identification rather than according to income, as income reflects not the individual income of the respondent but rather the total household income, including single and married people, dual-income and single-income households, pensioner households, and so on. Needless to say, as shown in Table 4, there is a considerably high correlation between academic background, household income, and stratum identification. In particular, as a high correlation coefficient exceeding 0.5 is found between total household income and stratum identification, there is no doubt that an economic base behind status consciousness exists, and although it is not as consistent as status consciousness itself, it is an environmental risk awareness factor. However, due to the reasons stated above, household income may differ from individual status consciousness in some cases. Therefore, status consciousness was used primarily as a socioeconomic status indicator that is consistently reflected by value consciousness and lifestyle.

Table 4. Educational Background, Income, and the Correlation Coefficient of Status Consciousness
(Pearson Coefficient, P. < .001)

	Educational background	Household income
Household income	0.345	
Status identification awareness	0.231	0.515

4. Risk Avoidance Behavior and Energy Policy Preference after the Fukushima Nuclear Power Plant Disaster

4.1 Radioactive Contamination Avoidance Behavior Due to Nuclear Disaster

Table 5 includes the results of the inquiry into radiation contamination avoidance behaviors after the nuclear disaster and residual radiation criteria for national food products (a provisional standard of less than 100 Becquerel per kilogram as of April 2012).

In recognition of the "irreversible processes" of environmental risks seen in the previous section, in contrast to the fact that the lower stratum generally took a more serious approach with regards to radioactive contamination from nuclear disaster, we can see that the upper stratum consistently adopts more aggressive evasive behaviors and have a stricter requirement for reference values of residual radioactive substances in food.

The proportion of replies for subjects in the upper stratum regarding "confirmation of grocery item origins [which prefecture, etc.]," "refrain from buying items with a high residual radioactivity," "more frequent use of bottled water," and so on, were higher than the lower stratum, showing a difference of around 10 points or more. As seen in the previous section, there is little hierarchical difference in recognition of the seriousness of the environmental risks for nuclear plants themselves, so the difference in radioactive risk avoidance behaviors is attributable to the difference in class access to information access resources and economic resources that enable the ability to select and purchase safer products with lower quantities. A staggering difference of 15.1 points between the upper and lower strata was found for "researched information about the nuclear disaster" and an additional 22 points for "I used the internet." In the lower strata, 25.2% responded with "I do not care about residual radioactivity in food," more than twice as high as the upper stratum. However, results seem to be greatly affected by insufficient economic means and access to informational access opportunities. It may be more accurate to say "they cannot afford to be concerned." As seen in Table 3, interest in synthetic chemical substances, pesticides, and food

additives, rather than being higher in the lower stratum, appears evenly across social stratifications.

Table 5. Risk Avoidance Behavior According to Stratum (%)

	Upper, upper middle	Lower middle	Upper lower, lower lower	Total
Confirm food product origins**	**68.0**	63.3	54.8	62.9
Refrain from buying items with a high residual radioactivity	46.5	46.9	39.4	45.2
More frequent use of bottled water*	**28.0**	24.4	18.3	24.2
Gather information (actively + to a certain degree) regarding nuclear disaster ***	**50.8**	42.5	35.7	43.6
Use the internet to gather information regarding topics such as radiation***	**57.8**	48.3	35.8	48.5
Residual radiation in food products "I'm not too worried about it"***	11.8	14.4	**25.2**	15.9
Residual radiation in food products "I do not buy it unless levels fall far below national standards"***	**25.8**	24.9	19.8	24.1

(X square significance level: * P. < .05, ** P. < .01, *** P. < .001)

4.2 Stratum Differences and Skew in Energy Policy Selection

Despite the fact that there is not much difference in risk consciousness per se, or rather, that the lower strata show more serious awareness, in terms of actual evasive behavior, a digital divide and economic disparity create a significant gap in behavior between the upper and lower stratum. Similar results are also seen in views on nuclear power plants and in the introduction of renewable energy.

Table 6 shows part of the results to the question "Should the ratio of nuclear energy be 0%, 15%, 20–25%, 25% or more?" (options used in the 2012 government hearings), regarding the introduction of renewable energy and electricity prices, as well as the preferred ratio of energy produced by nuclear power plants.

Looking at the question of nuclear energy ratio preference on the right side, the overall number of respondents who support "zero nuclear power" and respondents who support "15%" are both in the 30s, although in the majority, the percentage of "zero nuclear power" respondents was slightly higher for the middle to lower stratum. People in the upper stratum who responded that the nuclear energy ratio should be the "25% or more" ratios seen prior to March 11 are several percentage points higher than those in the lower stratum, either out of concern for a decline in living standards or due to a relatively high trust in science and technology.

Nevertheless, looking at the results to the question about electricity prices and the introduction of renewable energy on the left side of the table, total responses stating that "renewable energy should be advanced, *even if* electricity prices rise" were around 30%, with the upper strata about 10 points higher than the lower strata. Conversely, responses stating that "renewable energy should be advanced, to the extent that electricity prices *do not rise much*," were higher by about 10 points in the middle and lower stratum. It is thought that many of the supporters of "zero nuclear power," which accounts for around 35% of the middle and lower stratum, would naturally be strong supporters of renewable energy promotion policies. However, due to personal economic situations, preference for advancement of policies is limited to the extent that cost increases are as small as possible.

In summary, despite the fact that there is not much difference in the social hierarchy in terms of awareness of the seriousness of radiation as an environmental risk, with regards to risk avoidance behaviors which are actually costly, information-gathering behaviors, preference for policy countermeasures, etc., the presence/absence of economic margin to cost seems to largely influence the behavior and opinions of the upper stratum and the middle/lower strata. Interpreted from another angle, it could be said that the middle and lower strata inevitably have more serious environmental risk cognition than the upper stratum, as it is more difficult to participate in costly avoidance behaviors such as selection of purchases by

production area, or researching information. In addition, the middle and lower strata, where individual response to environmental risks is difficult, may at least have potential cognition of the "environmental (in) justice" of being exposed to significant risk.

Table 6. Opinions on the Promotion of Renewable Energy by Social Stratum, and the Ratio of Nuclear Power Generation to Total Electricity Generation (%)

	Renewable energy should be advanced, even if electricity prices rise***	Renewable energy should be advanced, to the extent that electricity prices do not rise much***		The ration of nuclear power should be zero*	The ration of nuclear power should be 25% or more*
Upper, Upper-middle	**37.3**	58.4		31.4	**17.0**
Lower middle	26.9	**69.1**		**35.8**	10.7
Upper lower, lower lower	27.5	**66.3**		**35.3**	11.5
Total	30.3	65.1		34.3	12.8

(X square significance level: * P. < .05, ** P. < .01, *** P. < .001)

5. Environmental Awareness, Environmental Behavior, and Risk Democracy Orientation

5.1 Social Stratification Differences in "Green Consumerism" Environmental Behaviors

It was Cotgrove and Duff (1980) who identified the elevation of the environmental movement since the 1960s as "middle-class radicalism." This is because the rich, newly created middle class that grew out of the period of high economic growth began pursuing the realization of "post-materialism" values such as environmental preservation.[5] Inglehart's "post-materialism" includes not only environmental conservation values but also decision-making process participation and participatory-democracy orientation as important items. But does high environmental consciousness and a positive attitude towards environmental conservation behavior lead to participation-oriented, risk-democracy-oriented decisions, such as setting standard values for environmental risks?

In terms of the seriousness of environmental risk cognition and general environmental concerns,[6] no discernible difference among the social strata was discerned. However, as can be seen in Table 7, when asked about practices in environmental conservation behavior, the difference is clearer. Although it is important to induce corporate environmental conservation attitudes through "environmentally friendly" consumption behavior, through movements like the "green consumerism" movement and the "socially responsible consumption" movement, in practice, differences in social stratification are apparent. Looking at the "green consumer" behaviors practiced by 30% to 40% of people, there is a difference of about 10 points between the upper and the lower strata for practices such as "choosing products which are better for the environment" and "purchasing products from environmentally friendly companies." Compared to these behaviors, although the number of participants is fewer, there is a clear difference even in people who purchase reasonably priced "fair trade" agricultural products from developing countries.

Of course, "environmentally friendly" consumption behavior often creates a somewhat higher cost burden than ordinary purchasing behavior, which is a somewhat more difficult for the lower stratum. It becomes a problem, then, to determine whether the passivity displayed in the lower stratum is due primarily to low consciousness or concern or is instead a matter of burden of cost. It is possible that the responses to "purchase local products and shop at local shops as much as possible" may offer a clue. "Local production" also contributes to lower energy and CO2 required for product transportation and to the

self-sufficiency of an area. Moreover, it is an environmental action where the burden of cost is usually not applicable. Regarding this survey option, given the fact that middle and lower strata are more actively involved in these behaviors than the upper strata, it is conceivable that the general passivity of the lower strata's environmental behavior is derived from a perception of cost burden rather than from a lack of cognition regarding nature. On the other hand, the positive attitude of the upper strata towards "green consumer" environmental behavior, rather than a uniquely high expression of "post-materialism values" would be more appropriately considered as an expression of the "environmental kindness" model commonly shared by all classes in a hierarchy with more financial resources.

Table 7. Environmental Behavior by Stratum (Post-Materialism, "Green Consumer" Behaviors, etc.) (%)

	Purchase products from environmentally friendly companies *	Choose products that are better for the environment*	Purchase "fair trade" agricultural products from developing countries as much as possible **	Purchase local products and shop at local shops as much as possible
Upper, upper middle	**36.8**	**46.9**	**14.4**	47.9
Lower middle	31.4	40.7	11.2	**53.9**
Upper lower, lower lower	26.1	36.6	7.6	**53.3**
Total	31.9	41.7	11.4	51.9

(X square significance level: * P. < .05, ** P. < .01, *** P. < .001)

5.2 Social Stratification Ambiguity in "Environmental Risk Democracy" Orientation

In environmental risk cognition, while the lower and middle strata show a more serious awareness of probabilistic environmental risks, they show significant difficulty in shifting this awareness to specific environmental behaviors due to a relative economic margin. It has been noted that while the lower and middle strata show a more aggressive risk aversion through environmental behaviors, such as preferred nuclear energy ratio, the more conservative upper strata has displayed an ambivalent cognizance and behavior indicating a preference for current conditions.

What, then, will be both positions regarding "environmental risk democracy," which includes citizen participation in environmental decision-making concerning acceptance of new technologies in more societal aspects, participatory democracy risk assessment, and so forth?

As mentioned at the beginning, the problem of "risk democracy" is based on the "production, distribution, and definition of risk" provisions of problem consciousness in Beck's *Risk Society*. Since the March 11 Fukushima Daiichi Nuclear Disaster in particular, people's environmental risk awareness and confidence in science/technology and experts have undergone significant transformation. The following shows the results (main answers) in descending order of the multiple response answers to this survey's question, "What in your day-to-day behavior has changed since the Great East Japan Earthquake/Fukushima Daiichi Nuclear Disaster?"

1. "Began to pay attention to reducing power consumption and energy conservation" (77.3)
2. "Began thinking for myself, not just believing the government and the media" (50.2)
3. "Responded to fundraising efforts for disaster-stricken areas or sent supplies" (46.3)
4. "Distrust of science/technology and experts increased" (32.8)
5. "Began reading books on nuclear power and radioactivity and researching information" (22.6)
6. "The bonds with my partner and/or family became stronger" (18.3)
7. "Began to think about contamination of playgrounds, schools, school streets, etc." (14.8)

More than 30% of people said their "distrust of science/technology and experts increased," and more than 20% of people began to think critically for themselves about nuclear power and radiation, perhaps reflecting the fact that half of respondents regretted their past reliance on the government and mass media concerning the safety of nuclear energy. No significant difference in the social hierarchy was seen for individual items. Many people experienced the absurdity that the level of risk had been deemed "acceptable" to a point beyond the logic of civilian life. To different degrees, they were forced to tolerate delays in disclosing nuclear power plant accident information and the diffusion of radioactive materials, fear of residual radiation in food and frustration with insufficient examination systems, and being forced to live in the "Radiation Control Area" area because the permitted space dose for a living space is up to 20 mSv per year. This experience seems to have encouraged awareness of the necessity of "risk democracy" in a variety of forms.

Table 8 shows one of the questions asked regarding "risk democracy" orientation. In response to the question "When introducing science and technology, as non-experts, should we reflect the opinion of the general public more, or should we rely on the judgment of experts?" responses were almost evenly divided. Although there is no data to compare with cognition prior to March 11, it is worth noting that more than 30% of people answered "inclusion of non-expert citizen participation," even though these results are slightly exceeded by a preference for "expert delegation." Looking at the results according to social stratification, although there is no significant difference, the upper strata shows a somewhat strong desire to defer to experts, while there is a tendency toward polarization in the lower stratum.

The polarizing tendency in the lower strata could be because, on the one hand, information access is limited and relative literacy regarding risk is poor, indicating a trend toward expert delegation, and on the other hand, it is inevitable that these strata, which are limited in actionable avoidance behaviors and susceptible to the influence of risk, would be oriented towards a stronger "environmental justice" aim at a stronger public participation.

Table 8. "Preferred Decision-Makers for Science and Technology Introduction Adoption/Rejection: Citizens or Experts" As Seen by Stratum (%)

	Should reflect the opinion of the general public that does not possess expert knowledge			Should be left to the judgment of experts rather than to the general public that does not possess expert knowledge	
	Agree	Somewhat agree	Neither agree nor disagree	Somewhat agree	Agree
Upper, upper middle	8.0	20.3	29.1	31.8	10.8
Lower middle	8.1	26.1	26.9	28.6	10.4
Upper lower, lower lower	11.7	25.3	24.2	26.4	12.5
Total	8.8	24.1	27.0	29.1	11.0

Impressions of the term "environmental risk" shown in Table 9 seem to be related to a preference for "expert delegation." At the time of this survey, terms such as "danger" were used, rather than "environmental risk," as it was still an uncommon term. Here, with an explanation of the impact on the environment and the human body expressed in numerical value (as in "the carcinogenic risk is one out of every 100,000 people"), subjects were asked which statement they more closely align with: "(environmental risk) can be evaluated more objectively and scientifically without influence from impressions and emotions" or "only the quantifiable side (of environmental risk), divorced from public opinion, is evident."

Results indicated that, as a whole, responses were nearly evenly split. However, the upper stratum was more likely to positively evaluate the concept of "environmental risks" as "more objective/scientific," with a majority answering that they "somewhat agree," while the lower stratum showed a clearly negative

evaluation of the concept, with a majority indicating that they "somewhat agree" with the idea that "only the quantifiable side, divorced from public opinion, is evident." It may be interpreted that such a high level of confidence in "objectivity/science" in the upper stratum is related, to some extent, to an inclination towards "expert delegation." (7) As for "risk democracy" orientation, however, preferences for "delegation to experts" or "non-expert citizen participation" indicate no clear correlation with hierarchical attribution, and it cannot be said to be a regulatory factor.

Table 9. Impressions of the Term "Environmental Risk" According to Social Stratum (%) (X square significance level: P. < .01)

	Can be evaluated more objectively and scientifically without influence from impressions and emotions			Only the quantifiable side, divorced from public opinion, is evident	
	Agree	Somewhat agree	Neither agree nor disagree	Somewhat agree	Agree
Upper, upper middle	**14.3**	**29.8**	22.6	24.6	8.8
Lower middle	10.3	26.1	27.1	29.1	7.4
Upper lower, lower lower	9.8	23.6	33.0	20.7	**13.0**
Total	11.4	26.7	27.0	25.8	9.1

5.3 "Risk Democracy" Orientation and Support for Nuclear Power Phase-Out Policies

While "risk democracy" orientation regarding citizen's participation democracy should be promoted in the scenario of standardization/evaluation of residual radioactivity of food and introduction of science technology, it cannot be directly derived from perceived stratum identification, though it is an element of the change to social orientation that occurred after March 11 which should not be ignored.

Table 10 shows the relationship between "risk democracy" orientation and "nuclear power phase-out/zero nuclear power policy." Table 10, in order, shows: citizen participation orientation and expert delegation orientation ("formulation of standards to handle residual radioactivity in food products"), citizen participation orientation and expert delegation orientation ("Is the judgment of scientists based on morals or on personal interest?" "introduction of science and technology"), impression of the "environmental risk" concept, and percentage of support for zero-nuclear-power policies. In each case, it was confirmed that individuals whose responses clearly indicated a preference for "citizen participation in the formulation of standards to handle residual radioactivity in food products," "distrust in the judgment of scientists," citizen participation in evaluation of introduction of science and technology," and "critical impression of the concept of 'environmental risk'" consistently show a "zero nuclear" policy support preference of about 50%, more than 10 points higher than the total 34.7%.

Table 10. Support for Citizen Participation in Decision Making and "Zero Nuclear Power" Policy Support (%)

Formulation of standards to handle residual radioactivity in food products	Zero nuclear power support**	Is the judgment of scientists based on morals or on personal interest?	Zero nuclear power support **	Should the introduction of science and technology be left to experts, or should they listen to the opinions of citizens?	Zero nuclear power support***	Impression of "environmental risk" theory	Zero nuclear power support **
Expert opinion is satisfactory	30.5	Based on morals	21.1	Should be left to experts	26.1	Objective, scientific	27.1
If I had to choose, I would choose an expert	32.5	Somewhat based on morals	26.4	If I had to choose, I would choose expert opinion	24.4	Somewhat objective and scientific	32.3
Both	36.9	Both	33.7	Both	38.3	Both	35.4
If I had to choose, I would choose public opinion	34.2	Somewhat based on personal interests	40.0	If I had to choose, I would choose public opinion	40.0	Deviates somewhat from public opinion	33.8
Should include citizens	**42.3**	Based on personal interests	**50.0**	Should include citizen opinions	**51.8**	Deviates from public opinion	**50.8**
Total	34.7	Total	34.7	Total	34.7	Total	34.7

(X square significance level: * P. < .05, ** P. < .01, *** P. < .001)

One of the most valuable findings of this survey with regard to risk democracy orientation is the reasonably consistent orientation perception of nuclear power policy, one of the biggest modern environmental issues. At the same time, it is difficult to directly explain this from attributes such as socioeconomic status. Above all, according to the findings of this survey, both the upper and lower strata of the social hierarchy experience ambivalence regarding economic and informational resource advantages, conservation of the status quo, "environment (in)justice" problem consciousness and awareness, and lack of actionable resources.

In order for the suppression factor among these to be dispelled and the "risk democracy" requirement to appear more straightforward, some kind of intermediary factor may be necessary. From this survey, it is presumed that factors such as "outlook for the future" or "disapproval" may serve as the intermediary factor to trigger social action.

Table 11, regarding "whether Japanese society is moving in a positive or negative direction," indicates the results of cross-tabulation for future outlooks concerning Japan and the desirable ratio of nuclear plants. Looking at this table, people who have an optimistic outlook with a tendency towards sustainability/conservation, indicate a desirable nuclear power ratio of "20–25%," close to pre-March 11 levels. On the other hand, people with a pessimistic outlook are polarized; people who support the "zero nuclear" policy are in the majority, but those who support the previous ratio of "over 25%" are also somewhat significant. It appears that the tendency to polarization of individuals with a pessimistic outlook can be explained depending on whether it is linked to the demands for social reform or to a state of resignation.

Table 11. Optimism/Pessimism Regarding the Future of Japanese Society and the "Nuclear Power Ratio" (%)

Nuclear power ratio/ future of Japan	Zero % nuclear power	15%	20–25%	More than 25%	
Positive outlook	25.7	28.6	**34.3**	11.4	100.0
Somewhat positive outlook	29.4	34.3	22.6	13.7	100.0
Neither positive nor negative	32.1	39.7	17.1	11.1	100.0
Somewhat negative outlook	**37.5**	31.4	17.2	**13.8**	100.0
Negative outlook	**54.3**	17.0	14.9	**13.8**	100.0
Total	34.5	34.4	18.5	12.6	100.0

(X square significance level: P. < .001)

Table 12 shows the relationship between "life satisfaction" and support for "zero nuclear power" policies. Explicitly, individuals who said that they were "dissatisfied" are mostly supporters of "zero nuclear power" policy, and few people expressed a "satisfied" opinion. As there is no tendency in the responses to the other options, there is no significant difference as a whole. However, there is a clear trend in the portion where a no-nuclear-power policy is supported by people who are "dissatisfied." Incidentally, in terms of satisfaction and future prospects for Japanese society, there is a moderate correlation with stratum consciousness. In the lower stratum, there is a significant amount of support for a "zero nuclear power" policy. However, this survey was unable to ask questions regarding specific policy orientation and the style of engagement, such as "separation of electrical power production from distribution/transmission" policies, intent to purchase "green power" technologies, and so forth.

In the future, a survey is necessary which more effectively incorporates awareness, including socioeconomic status variables, intermediate variables such as social participation and degree of satisfaction, and variables related to environmental policies and social policy preferences.

Table12. Life Satisfaction and the "Nuclear Power Ratio" (%)

"Nuclear power ratio"/ life satisfaction	Zero % nuclear power	15%	20–25%	More than 25%	
Satisfied	26.7	35.3	24.1	13.8	100.0
Somewhat satisfied	29.4	34.3	19.6	13.1	100.0
No preference	36.0	36.9	12.3	14.8	100.0
Somewhat dissatisfied	33.8	39.0	18.6	8.6	100.0
Dissatisfied	**43.7**	27.6	17.2	11.5	100.0
Total	34.5	34.4	18.5	12.6	100.0

(X square significance level: P. = .111)

6. Conclusion

The starting point of this survey is that the probabilistic environmental risk calculation is R = H × P, which is scientifically applied to "uncertain environmental risks" and influences "irreversible/catastrophic environmental risks," which often serve as political ideology for accepting new technology. "Three types of environmental risk" were hypothetically set, with initial plans to verify whether environmental risk perception actually performed by citizens is a more segmented model.

Remarkably, the Great East Japan Earthquake and Nuclear Disaster occurred during this process, and problems such as radiation risk avoidance behavior, and considerable stratification differences in risk cog-

nition were noticed. Therefore, a hypothesis was built regarding the relationship between risk types and social stratification. In particular, the development of "risk democracy" demands for nuclear power, radioactive contamination, etc., which require more open information disclosure and opportunities, was observed.

The findings are summarized as follows.

First, regarding the three types of environmental risks, the question items and methods used to assess risk cognition were insufficient, but a certain difference with respect to the "effect of irreversible processes" and "bias" was distinguished between "probabilistic risks" such as automobile exhaust gas, "uncertain risks," such as synthetic chemical substances, and "irreversible/catastrophic environmental risks," such as nuclear energy.

Second, in relation to social stratification, the lower stratum is more susceptible to those effects, and is more aware of known risks in particular, while the upper stratum did not show much difference in perception of the seriousness regarding risk. However, behaviors such as information collection and evasive behavior for new risks, including radioactivity, were confirmed. Regarding environmental risks, social stratification was indicated to bring about differences in information access and emergency response behaviors through economic resources, such as collecting information and cost burden necessary for avoidance behaviors.

Third, recognition of environmental risks leads to policy demands. Looking at the process of sublimation, there are ambivalent circumstances in the upper and lower strata of social stratification, respectively. There is a relative economic margin in the upper stratum, and although it is active in "post-materialism" environmental behaviors, such as "green consumerism," as beneficiaries of the present society, they show a basic sense of trust in experts/scientists. However, it is difficult to say whether they show a strong orientation towards radical "risk democracy," as in citizen "zero nuclear power" policy and participation in the risk assessment process. Conversely, in the lower stratum—a more vulnerable group with difficulty practicing avoidance behaviors—the sense of danger regarding environmental risks (in particular, with known risks) is stronger, and while in a position to possess a sense of problem consciousness and environmental (in)justice consciousness, it lacks the resources necessary for action.

Fourth, to that end, a direct correlation between "risk democracy" orientation and social stratification is not clearly seen, though "risk democracy" intent became obvious through intermediary factors such as distrust and dissatisfaction with society, and the need to restructure the hypothesis was recognized.

In the changes to environmental consciousness after March 11, re-examination of environmental risks occupies a prominent position. Notably, confidence in the scientific discourse of risks related to nuclear power has decreased significantly, and the reality that it has been used in political ideology to encourage public acceptance was exposed. In particular, when evaluating new risks—including nuclear plants, GMOs, and nano-technology—that can cause irreversible damage to ecosystems and bodies, changes to the system must be made to ensure decision-making by securing a place for controversial democracy and participatory democracy/open debate. In this way, non-expert citizens will be guaranteed opportunities to protest on behalf of future generations and ethical/ecological systems, complete information disclosure, and deliberative democracy. I believe that the sociological study of environmental risk can contribute to such tasks, by continually recalling the social and economic stratification of points of view that are likely to be overlooked, including disproportionate distribution of environmental risks and the problematization of social justice.

Notes

(1) In North America, about 70–80% of potatoes, corn, soybeans, rapeseed, and other such crops are said to be genetically modified. Although these crops are sold in Japan, domestic cultivation is still not permitted. Problems with GMOs include doubts regarding the safety of Bt toxin genes and the

like, which are incorporated to be insect-resistant. In addition, there has been criticism of monopolization by multinational companies such as the Monsanto Company, which profit from the exclusive sale of herbicide-resistant recombinant seeds and herbicides. Recombinant seeds such as rapeseed cross-fertilize with weeds such as Brassicaceae, and by doing so, they disrupt ecological genetic information.

(2) According to Noriyuki Suzuki (2009, chapter 3), from a point of view of an environmental chemist, while evaluation of carcinogens, such as dioxin, is possible, evaluation failed with regards to unconfirmed environmental hormonal risks.

(3) "Post-materialism values" are a concept raised by Inglehart (1977=1978). To wit, it is pointed out that after a wealthy society is brought about through industrialization, and lifestyle support, income, and basic living needs such as consumer goods ("materialistic value"), are satisfied, the pursuit of "post-materialism values," such as self-actualization, participation in decision-making, environmental conservation, and so on, will become more important in developed countries. In the social hierarchy, "post-materialism values" are more conspicuous in the middle and upper classes.

(4) The reason for the small difference in academic background is unknown, but Mito, one of the survey areas, is a region with a strong industrial base, including Hitachi and nuclear power plants; Kawasaki is a region with similar tendencies. Although such regional characteristics may also affect the character of the highly educated strata, such speculation is not covered in this survey.

(5) Cotgrove and Duff (1980) explained that post-materialism values in the occupation hierarchy are stronger in social and interpersonal services that are less dependent on the economy, such as in the new middle class located between economic growth-oriented management and workers, including civil servants, teaching staff, and welfare workers.

(6) This survey also included items regarding "issues of tropical rainforest destruction and desertification," the "export of hazardous waste to developing countries," and "dioxin and environmental hormones," but there were no noticeable differences between social strata.

(7) Although the table itself is not presented, responses with a positive "environmental risk" view that are "objective, scientific" and the expert commission trend in the introduction of science and technology show a clear, positive correlation.

References

Beck, U., 1986, *Risikogesellschaft: Auf dem Weg in eine andere Moderne* (*Risk Society*), =1998. *Risk Society*, translated by Ren Higashi. Hosei University Press.

Bullard, R., and B. Wright. 1992=1993. *The Quest for Environmental Equity*, edited by Riley E. Dunlap and Angela G. Mertig, translated by Hisayoshi Mitsuda. American Environmentalism. Minerva Shobo.

Cotgrove, S., and A. Duff. 1980. "Environmentalism, Middle-Class Radicalism, and Politics." *Sociological Review*, vol. 28, no. 2, pp. 333–351.

Hannigan, J.A. 1995. *Environmental Sociology: A Social Constructionist Perspective*, =2007, translated by Matsuda Tsuyoshi. Minerva Shobo.

Inglehart, R. 1977. *The Silent Revolution*, =1978translated by Ichiro Miyake. Toyo Keizai Shinposha.

Murota Takeshi. 1986. *Economics of Nuclear Power*, new edition. Nippon Hyoron-sha. (Japanese)

Nakanishi Junko. 1995. *Environmental Risk Theory*. Iwanami Shoten. (Japanese)

Nakanishi Junko. 2004a. *Environmental Risk Studies*. Nippon Hyoron-sha. (Japanese)

Nakanishi Junko. 2004b. "Risk Assessment and Risk Management Approach." *Thought, Risk and Society*, July. Iwanami Shoten. (Japanese)

Nakayachi Kazuya. 2003. *Environmental Risk Psychology*. Nakanishi Shuppan. (Japanse)

Shrader-Frechette, K. 1991. *Risk and Rationality*, =2007, translated by Matsuda Tsuyoshi. Showado.

Slovic, P., 1987. "Perception of Risk." *Science*, vol. 17, pp. 280–285.

Suzuki Noriyuki. 2009. *Reconsidering Environmental Risks*. Maruzen. (Japanese)
Terada Ryoichi. 1998. "Institutionalization of Environmental NPOs (Private Nonprofit Organizations) and the Transformation of the Environmental Movement," *Journal of Environmental Sociology*, no. 4, Shin-yo-sha. (Japanese)
Terada Ryoichi. 2001. *Industrial Waste and Regional Environmentalism*, edited by Nobuko Iijima, "Environmental Sociological Studies on Waste Problems," Tokyo Metropolitan University Press. (Japanese)
Terada Ryoichi. 2008. "Environmental Risk Society and Environmental Information Democracy: PRTR System Case Study," *Meiji University Journal of Psycho-Sociology*, vol. 3, pp. 33–47. (Japanese)
Terada Ryoichi. 2011. "Environmental Risk Theory and Environmental Sociology." *Journal of Psycho-Sociology*, vol. 6, pp. 51–71. (Japanese)
Yoshioka Hitoshi. 2011. *Social History of Nuclear Power in Japan*. Asahi Shimbun. (Japanese)
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