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Paper:

Citizen Satisfaction and Continuing Intentions Regarding Support and Compensation Prescribed by the Chernobyl Act: A Case Study of the Russian Central Federal District

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Using the case study of the Russian Central Federal District, this paper analyzes the degrees of satisfaction among citizens regarding the support and compensation as prescribed by the Chernobyl Act, and their desire for this support to continue. After the Chernobyl nuclear disaster, the Chernobyl Act named the State as being responsible for compensation of damages and provided that liquidators and refugees could receive support. Using a questionnaire survey, citizens' levels of satisfaction concerning this support, as well as the speed of response to the nuclear accident, the information provided by the government, the decontamination of heavily polluted forests, and the compensation for liquidators were evaluated. The results found that support measures regarded as necessary for the reconstruction of affected areas and development of society and economy were the continued observations of the health status of the affected people, and continued pollution control. The degree of satisfaction among women and those with children, who are given preferential treatment under the Chernobyl Act, was high in regard to the Russian government's response to the accident. Conversely, there are many who feel negatively about the provision of company housing and housing to citizens as prescribed under the law. Overall, 80% of the respondents wanted to continue support for the victims, particularly those with children, and desired to continue support such as migration rights, the early receipt of pensions, and the provision of free medicines, but many did not want preferential treatment regarding rent subsidies. Citizen satisfaction was generally high concerning the support and compensation as defined by the Chernobyl Act. However, there were also negative opinions regarding the preferential treatments prescribed by law, and it is necessary to consider these measures when formulating laws to protect victims in the future.

Keywords: Russian Federation, Chernobyl Act, liquidator, compensation and support of the nuclear plant accident, ordered logistic regression analysis

1. Study Subject

In March 1985, Mikhail Gorbachev was installed as the General Secretary of the Communist Party Central Committee of the Soviet Union at the age of 54 [1]. In his acceptance speech, he called for more "glasnost" [openness] in the "party, State, and social organizations [1]." Glasnost, or openness, was promoted as a part of the important information policy of "perestroika" [restructuring]. However, on April 26, 1986, one year after Gorbachev took office as the General Secretary, the worst nuclear accident in history occurred at nuclear reactor Unit No. 4 of the Chernobyl nuclear power plant [1]. This accident became the greatest trial for glasnost which was being promoted by Gorbachev. The Soviet newspapers, television stations, and government had remained silent about the accident and were criticized by the international community [1]. Three weeks after the accident, Gorbachev began the undertaking of a reform to promote the disclosure of information as the nuclear accident had not been accurately reported, yet, it was not until March 20, 1989 (three years after the accident) that Pravda released a contamination map of certain areas outside of the 30 km Fallout Zone [2]. Subsequently, a contamination map that covered a wider region was released which showed that radioactive substances had spread to areas that were several hundred kilometers from the nuclear plant, and this prompted citizen movements that demanded relief measures from the consequences of the nuclear accident in Belarus and Ukraine to become active [2]. On April 25, 1990, the Supreme Soviet of the Soviet Union adopted a resolution that recognized that the consequences of the nuclear accident could not be liquidated by the release of isolated pieces of information, or by ad-hoc relief measures [2]. The so-called Chernobyl Act specifically addressed the protection of the citizens that had suffered from the consequences of the Chernobyl catastrophe, and was adopted in the Republic of Ukraine and Belarus in February 1991, and in April of the same year in Russia [2]. In August 1991, Ukraine declared Independence from the Soviet Union, while the Soviet Union dissolved at the end of the year. The Act re-

mained in the three countries after Independence, where it is still in force [2].

Among the studies dealing with the Chernobyl nuclear plant accident, Renn [3] performed a (social) psychological study on radiation risks and nuclear disasters, while Van Der Pligt and Midden [4] and Arkhagelskaia et al. [5] studied the difficulties of informing residents about the issues of radiation protection. Meanwhile, epidemiological studies on radiation risks included Bandazhevsky [6], who studied the medical and biological effects of radioactive cesium on the human body, and Bandazhevsky et al. [7] who studied its medical and sociological effects on the reproductive system.

Omatsu [8] pointed out that, although a law that addresses the effects of the Fukushima Daiichi nuclear power station accident has been adopted in Japan subsequent to March 11, 2011, there has been no law that clearly specifies the "areas affected by the nuclear accident" that would be considered for compensation, or the "nuclear accident victims" who should receive compensation.[1] Further, he points out that Japan has no law that determines the obligations of a long-term protection which extends over the victim's lifetime, the following generation, or of the nuclear accident victims; nor one that defines the State's legal responsibility to deal with the unresolved effects over a wide area. In the nations directly affected by the Chernobyl accident, the victims are protected by the Chernobyl Act and continue to receive compensation by the State, which is markedly different from Japan [2]. However, despite the progress of glasnost in the pre-collapse of the Soviet Union following the Chernobyl disaster, the citizens were still unable to voice criticisms of social issues. Researchers such as Bandazhevsky, who had criticized the government's response to the residents who had been exposed to radiation, were arrested, imprisoned, and prohibited from continuing their research.[2] For this reason, there have been no studies that examine the social issues associated with the Chernobyl nuclear power plant accident, or include the manner in which the citizens evaluated the benefits or compensation as stipulated by the Chernobyl Act in Russia, although there were studies on the psychological effects or medical research.[3]

1. Since March 11, 2011, several laws relating to the Fukushima Daiichi nuclear power plant accident have been adopted, including the Act on Special Measures for the Reconstruction and Revitalization of Fukushima (March 31, 2011), in which the reconstruction and recovery of Fukushima prefecture are positioned as important issues; the Nuclear Damage Compensation Facilitation Corporation Act (August 10, 2011), which stipulates the use of national funds to facilitate compensation; and the Act on Special Measures concerning the Handling of Pollution by Radioactive Materials (August 30, 2011), which defines the high priority areas to be surveyed for contamination status, among other laws [8].
2. Bandazhevsky published [6] and [7], although the Belarus government maintained that radiation had little effect on human health. He was arrested and detained in 1999 under charges by the Belarus authorities that he had received a bribe from the family of an applicant of the Gomel State Medical University. In June 18, 2001, Bandazhevsky was sentenced to eight years in prison. The University's Deputy Director, Vladimir Ravkov, also received an eight-year prison sentence.
3. There have been other studies of disasters than the Chernobyl nuclear plant accident. Funabashi [9] examined the kind of policies that agencies need to bring about social change, the revitalization of local communities after the Great East Japan Earthquake, and the conceptual framework for victim support. Meanwhile, in collaboration with the Asahi Shimbun newspaper, Imai [10] conducted a fact-finding survey of the evacuees from the Fukushima Daiichi nuclear power plant accident. Yet, there have been few surveys in Japan that have been conducted to assess the citizens' views.

Thus, to implement a socially effective policy, it is essential to have the victims, who are the concerned party and main beneficiaries, evaluate the policies practiced in Russia. Previous studies have not provided sufficient material for policy evaluation, nor have they involved citizens to assess their direct evaluation of the relevant policies or analyze their results.

Therefore, this paper uses the case of the Central Federal District of Russia to statistically analyze and discuss to what extent citizens are satisfied with the benefits and compensation as stipulated in the Chernobyl Act, and whether they agree with continuing the benefits and compensation measures.

2. Method of Research

2.1. Organization of This Paper

This paper is organized in the following manner.

Section 2 describes this paper's composition, the design of the questionnaire survey, and the method of comparison which constitutes the method of research.

Section 3 presents the designation criteria of affected areas and the zone classifications as stipulated in the Chernobyl Act, and reviews the radioactively contaminated areas in Russia. We sum up the Act's features and discuss the victims and benefits as stipulated in the Act.

Section 4 presents the findings of the questionnaire survey on whether the respondents had experience in the cleanup (liquidation) work of the nuclear accident or evacuation, or whether they remembered the accident, trusted the information provided by the Russian government, or felt that the government's response to the accident was timely. We discuss the citizens' views on the various consequences of the accident and the continuation of the victim's benefits.

Section 5 statistically analyzes how the citizens' satisfaction levels, with the benefits and compensation measures as stipulated by the Chernobyl Act, are related to the individual attributes and measures required for the reconstruction or social and economic progress of affected areas. In addition, we statistically examine whether the future continuation of the victim's benefits is related to the individual attributes or the compensation and benefits as stipulated by the Chernobyl Act.

Section 6 summarizes the degree of satisfaction among citizens with the benefits and compensation as stipulated by the Chernobyl Act, and their views on its continuation. We discuss the compensation and benefits necessary for areas affected by the Fukushima Daiichi nuclear plant accident in Japan.

2.2. Survey Design and Comparison Method

2.2.1. Survey Design

In this Section, we describe the survey design. Although the victims designated under the Chernobyl Act

are entitled to receive compensation and benefits, the subsidies allotted for benefits as determined by the Act have been drastically curtailed since the mid-2000s.[4] There has been criticisms that only around 20% of the stipulated measures have been implemented [8]. However, measures such as medical check-ups have had an implementation rate that has exceeded 95%, and it is only because of the State's responsibility being set forth in the Act that this program has continued for over 30 years since the accident [8]. For the survey, the questionnaire was designed to assess to what extent the citizens were satisfied with the benefits and compensation measures as stipulated by the Act, and whether they agreed with the future continuation of these measures. Since the subsidies and budgetary allotments for the benefits as stipulated in the Act have been curtailed, we set the following hypothesis as "The citizens' degree of satisfaction is low," and examine whether this hypothesis holds true or not.

To conduct the survey, we produced an Internet questionnaire using SurveyMonkey, and submitted it to a consumer panel administrated by the software solutions company Cint. The questionnaire was composed in the Russian language, and was administered in the Central Federal District on 302 participants. The questionnaire responses were gathered from December 10 to 14, 2018.

A quota sampling method is sometimes used in surveys where the population is divided into groups according to combinations of sex, age, and so on, and from which a sample group is selected so that the characteristics of the population are reflected. Although SurveyMonkey allows the extraction of sample groups for each Federal District in Russia, sampling cannot be done in some federal subjects of the Central Federal District; thus the sample group was selected to follow the characteristics distribution of the population for the consumer panel. We recognized that the sample may be biased in the Internet-based survey, since a large portion of respondents tended to be from Moscow and its vicinity where the population is high, and that there were likely to be fewer respondents of middle and older ages, and more with higher education such as engineers or university graduates.

2.2.2. Method of Comparison

The sample group was compared with those of five countries previously investigated, Germany [11], France [12], Finland [13], Ukraine [14], and Belarus [15], in regard to the following three items: how much the respondents remembered of the nuclear accident (memory of nuclear plant accident); how much they trusted the government-provided information about the accident (reliability of the government's information); and whether they felt that there was a fast response (rapidity of government's response to the accident). The questions concerning these three items were phrased identically in the questionnaires for the different countries, allowing for comparison of these three items between the citizens of Russia and the other five countries. Further, we analyzed whether a statistically significant difference existed between the groups of Russia and the five countries with regard to the "memory of the nuclear plant accident" and the "rapidity of the government response to the accident." The six countries were combined for statistical analysis, where the same model (ordinal logit model) and the same objective and explanatory variables were used for analysis. The statistical model is described in detail in Section 5: Method of analysis.

3. Radionuclide Contaminated Areas in Russia, and the Victims and Their Benefits Designated from the Chernobyl Act

3.1. Radionuclide Contaminated Areas in Russia Due to the Chernobyl Nuclear Power Plant Accident

The Chernobyl nuclear power plant accident produced radioactive substances that contaminated areas in Ukraine, Belarus, and Russia.[5] As of 1991, the Chernobyl Act stipulated that the areas where the additional annual radioactive exposure dose exceeded 1 mSv were "radioactively contaminated territories," and those areas where the annual radioactive exposure dose exceeded 5 mSv were designated as the (obligatory) Resettlement Zones, from which the residents were required to resettle to another location [2].

Figure 1 shows the soil contamination density of cesium-137 in Ukraine, Belarus, and Russia. In the Chernobyl Act, the radiation contaminated areas are divided into four Zones [2, 8, 17].

The first category, although not shown in the map, is the "Exclusion Zone" (Zone 1) as stipulated by a standard distance (30 km Zone around the Chernobyl nuclear power plant), and is the territory from which "the population has been evacuated according to the norms of radiation safety in 1986 and in subsequent years." In principle, no one is allowed to live there (Non-Habitable Zone).

The second category is indicated by the red zones that correspond to the soil contamination levels of 1,480–3,700 kBq/m^2, and is referred to as the "Resettlement Zone" (Zone 2). In principle, the residents are required to resettle to another location.[6] The corresponding areas in Russia lie in the Bryansk region along the border with Belarus (Non-Habitable Zone).

The third category lying within the darker orange zones corresponds to soil contamination levels of 555–1,480 kBq/m^2, and consists of areas where the annual additional radioactive exposure dose is 5 mSv or greater. The residents are required, in principle, to resettle (Non-Habitable Zone).

The fourth category, also lying within the darker or-

4. Between 1996 and 1998, 50–60% of the budget required to implement the Chernobyl Act was disbursed, and only around 14% was disbursed during the period 2003–2010 [8].

5. See Nakamura and Masuda [16] for the respective areas contaminated by cesium-137 in the three countries that were directly affected by the Chernobyl accident.

6. In the Belarus Chernobyl Act, this corresponds to the priority Evacuation Zone [16].

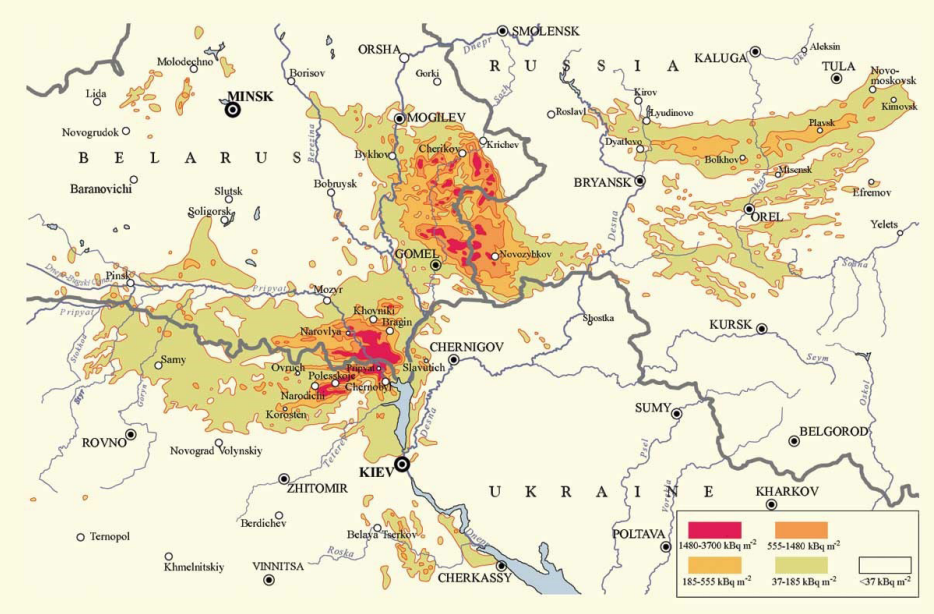

Fig. 1. Cesium-137 contamination map of Ukraine, Belarus, and the Russian Federation. Source: International Atomic Energy Agency (IAEA), "Environmental Consequences of the Chernobyl Accident and their Remediation: Twenty Years of Experience," p. 25, 2006 (https://www-pub.iaea.org/mtcd/publications/pdf/pub1239_web.pdf).

ange zones that correspond to soil contamination levels of 555–1,480 kBq/m^2, consists of areas where the annual additional radioactive exposure dose is less than 5 mSv, and where the residents have a right to resettle, and for which they can receive benefits (Habitable Zone with the Right of Resettlement).[7] The areas in Russia that correspond to the third and fourth categories, with soil contamination levels of 555–1,480 kBq/m^2, include the vicinities of Novozybkov and Klintsy that are close to the Belarus border.

The fifth category, as indicated by the light orange zones that correspond to soil contamination levels of 185–555 kBq/m^2, is the "Habitable Zone with the Right of Resettlement" (Zone 3).[8] Here, if the annual radiation dose is 1 mSv or greater, the residents have the right to resettle if they wish to do so and are eligible to receive benefits. The areas in Russia corresponding to this Zone lie along the east-west direction and are located in the eastern part of the Bryansk region, the Bolkhov vicinity in the Oryol region, and Plavsk in the Tula region.

The sixth category, as indicated by the light green zones that correspond to soil contamination levels of 37–185 kBq/m^2, is the "Habitable Zone with Privileged Social-Economic Status" (Zone 4).[9] Here, the annual radiation dose is 1 mSv or less and the residents do not have rights of resettlement, but receive benefits centered on medical services such as medical examinations and health improvement holidays. If a physician deems it to be necessary, pregnant women and households with children are given the right to resettle. The areas in Russia with soil contamination levels of 37–185 kBq/m^2 lie in the outlying areas of the Bryansk region, and encompass an extensive area that stretches from the western vicinities of Roslavi in the Smolensk region, Lyudinovo in the Kaluga region, and Mtsensk in Oryol region, and to the eastern vicinities of Novomoskovsk and Klimovsk, which are both in the Tula region (see **Fig. 1**).

3.2. Victims and Their Benefits as Stipulated in the Chernobyl Act

After the Soviet Union collapsed at the end of 1991, the Chernobyl Act was continued by Ukraine, Belarus, and Russia.[10] The Chernobyl Act actually consists of two laws: one "on the legal status of contaminated territories," which defines the areas that were contaminated; and one "on the status of the victims," which defines who the citizens affected by the accident are, their rights to receive compensation, and the type of compensation [2, 8]. The features of the Chernobyl Act, as a law to protect the victims of the nuclear accident, are its "wide scope of coverage," "long-term coverage," and "clear responsibility on the State" [8].

As for its "wide scope of coverage," the "citizens affected by the consequences of the Chernobyl nuclear plant accident" consist of liquidators (those who engaged in the cleanup, or liquidation, of the Chernobyl accident), those who evacuated, and those who continue to live within the contaminated areas [8].

7. In the Belarus Chernobyl Act, this corresponds to the secondary Evacuation Zone [16].
8. In the Belarus Chernobyl Act, this corresponds to the Zone with the Right of Resettlement [16].
9. In the Belarus Chernobyl Act, this corresponds to the Zone that continues to be inhabited, and where regular radiation monitoring is performed [16].
10. See Komorida [18] and Omatsu [19] for the Russian Chernobyl Act, Takemori [20] for the Ukraine Chernobyl Act, and Nakamura and Masuda [20] for the enactment process of the Chernobyl Act.

Table 1. Victims and their benefits as recognized by the Chernobyl Act (as of 2014).

Category	Target	Main benefits and compensations	
Liquidator	Citizens that engaged in liquidation of the Chernobyl nuclear plant accident during 1986-1990. Workers in the 30 km Zone.	• Free medicines • Preferential treatment for housing guarantee • Free or reduced fees for health improvement holidays • Compensation to surviving family members	Lifetime medical examinations, preferential treatment of pensions, and other social security benefits.
Evacuees	Those forcibly evacuated from the 30 km Zone. Those residing outside the 30 km Zone in an area where the annual radiation dose exceeds 5 mSv and were thus obligated to resettle. Those residing outside Zones 1 and 2 as above, in an area where the annual radiation dose exceeds 1 mSv, and that voluntarily resettled.	• Compensation of real estate and property owned in the evacuated Zones • Provision of housing in resettled locations • Guaranteed employment in resettled locations • Lump-sum payment for resettlement • Subsidies of relocation expenses • Free or reduced cost of medicines • Free or reduced fees for health improvement holidays	
Residents of contaminated areas	Residents of areas where the soil contamination level is 37 kBq/m^2 and the annual effective radiation dose is 0.5 mSv.	• Free or reduced cost of medicines • Free or reduced fees for health improvement holidays • Monthly allowance to purchase food from uncontaminated areas	

Source: R. Omatsu, "3.11 and Chernobyl Act – Inheriting the Wisdom for Reconstruction," Toyoshotenshinsha, 2016 (in Japanese).

Further, the "areas targeted for support" consist not only of the area that surrounds the Chernobyl plant and that is under the jurisdiction of the local government but an extensive area where the soil contamination level exceeds 37 kBq/m^2.[11] The area targeted for support extends across the three countries as shown in **Fig. 1**.

It is presumed in the Chernobyl Act that the consequences will last over a long period, and the citizens that are legally recognized as victims are promised free medical examinations throughout their lifetimes [8]. Further, the children born after the accident are also recognized as victims if certain conditions are met [8].

The Chernobyl Act clearly stipulates that the responsibility to protect these victims and compensate them for the consequences of the accident lies in the State [8].

Table 1 presents the victims and the major benefits as recognized by the Chernobyl Act (as of 2014).

Liquidators are entitled to free medicines, preferential treatment in housing guarantees, free or subsidized health improvement holidays, and compensation for surviving families.

Those that have resettled, in addition to free medicines and free or subsidized health improvement holidays, are entitled to receive compensation for real estate and property in their former (i.e., evacuated) areas, and guaranteed housing and employment security, a lump-sum payment for resettlement, and subsidies for relocation expenses.

Residents of contaminated areas, in addition to free medicines and free or subsidized health improvement holidays, are entitled to receive monthly allowances to purchase food from uncontaminated areas.

Thus, the victims recognized under the Chernobyl Act are entitled to receive various benefits, lifetime medical examinations, and preferential treatment in pension payments and other social security benefits.

4. Outline of Survey Results

4.1. Attributes of the Sampled Group

Table 2 presents the attributes of the sampled group. In terms of gender distribution, 43% were men and 57% women; 55.3% belonged to a family that included a child (or grandchild) that was 12 years old or younger; 54.3% resided in the city of Moscow and 11.9% in Moscow Oblast; thus 66.2% lived in Moscow Oblast including Moscow. Of the respondents, 3.3% lived in Oryol Oblast and 3.3% in Tula Oblast, both of which include extensive areas that are classified as being in Zone 4. Meanwhile, the residents of Bryansk Oblast, where the radioactive soil contamination is serious, constituted only 1.3%. In terms of occupation, office workers had the highest share with 32.1%, followed by engineers and professionals (22.2%) and government employees (12.3%). The average age was 40.4, with those in their 30s (37.4%) accounting for the largest age group, followed by those in their 40s (31.8%),

11. The radionuclide contaminated areas as stipulated by the Chernobyl Act are areas in which the soil contamination density of cesium-137 is higher than 37 kBq/m^2, and that of strontium-90 is higher than 5.5 kBq/m^2, and that of plutonium-238, -239, or -240 is higher than 0.37 kBq/m^2 [16].

Table 2. Attributes of sample group ($n = 302$).

Individual attribute		Frequency	Percentage	Individual attribute		Frequency	Percentage
Sex	Male	130	43.0%	Child	With child 12 years of age or under	167	55.3%
	Female	172	57.0%		Without child 12 years of age or under	135	44.7%
Age	20-29	43	14.2%	Occupation	Office worker	97	32.1%
	30-39	113	37.4%		Government employee	37	12.3%
	40-49	96	31.8%		Factory worker	14	4.6%
	50-59	42	13.9%		Engineer, professional	67	22.2%
	60-69	7	2.3%		Self employed	21	7.0%
	70 and above	1	0.3%		Housewife, househusband	27	8.9%
	Mean, S.D.	40.4	10.0		Retired	18	6.0%
Education received	High school	19	6.3%		Seeking work	7	2.3%
	Two-year college, vocational school	52	17.2%		Student	4	1.3%
	University	164	54.3%		Receiving medical treatment, on leave of absence, on maternal leave	2	0.7%
	Graduate school	67	22.2%		Other	8	2.6%
Residence (Central Federal District)	Moscow city	164	54.3%	Mean and S.D. of household size		3.36	1.1
	Belgorod oblast	3	1.0%	Monthly income	10,000 RUB or less	15	5.0%
	Bryansk oblast	4	1.3%		10,001-20,000 RUB	43	14.2%
	Vladimir oblast	5	1.7%		20,001-30,000 RUB	42	13.9%
	Voronezh oblast	18	6.0%		30,001-40,000 RUB	48	15.9%
	Kostroma oblast	3	1.0%		40,001-50,000 RUB	48	15.9%
	Kaluga oblast	4	1.3%		50,001-60,001 RUB	30	9.9%
	Ivanovo oblast	6	2.0%		60,001-70,000 RUB	15	5.0%
	Kursk oblast	4	1.3%		70,001-80,000 RUB	14	4.6%
	Lipetsk oblast	9	3.0%		80,001-90,000 RUB	16	5.3%
	Moscow oblast	36	11.9%		90,001-100,000 RUB	9	3.0%
	Oryol oblast	10	3.3%		100,001-120,000 RUB	11	3.6%
	Ryazan oblast	2	0.7%		120,001-140,000 RUB	3	1.0%
	Smolensk oblast	7	2.3%		140,001-160,000 RUB	2	0.7%
	Tambov oblast	4	1.3%		160,001-180,000 RUB	2	0.7%
	Tver oblast	1	0.3%		275,001-300,000 RUB	1	0.3%
	Tula oblast	10	3.3%		300,000 RUB or over	3	1.0%
	Yaroslavl oblast	11	3.6%		Mean, S.D.	49,553	42,460

Source: Based on the survey results from SurveyMonkey.
Notes: (1) Child refers to those that attend junior high school and younger.
(2) The mean and S.D. of ages and incomes are computed from class values.
(3) Other includes two medical professionals and two teachers.

20s (14.2%), and 50s (13.9%).[12] In terms of educational background, university graduates constituted the largest group (54.3%), followed by those graduating (22.2%), and two-year colleges and vocational schools (17.2%).[13] The average monthly income was RUB 49.553, which is equivalent to USD 748.25 (at the exchange rate of RUB 1 = USD 0.0151). This amounted to an average yearly income of USD 8,979, which is lower than the per-capita nominal GDP in Russia of USD 10,956 in 2017 (IMF). The value of the Ruble against the U.S. dollar sharply declined in 2018, and may have been reflected in the decline in income levels. The income categories of RUB 30,001–40,000 and RUB 40,001–50,000 were the largest groups and each accounted for 15.9%, followed by RUB 10,001–20,000 at 14.2% and RUB 20,001–30,000 at 13.9%.

12. The average age in Russia is 38.73 (United Nations, 2015). Those under 15 make up 17.61% of the population, while those between the ages of 15–64 make up 68.22%, and those that are 65 and over account for 14.18%. Since the surveyed sample contained no one under the age of 19, the average age is slightly higher for the country.
13. The percentage of the population that has graduated from university is 53.06% (OECD, 2016), which is roughly the same as in the present survey.

4.2. Experience in Nuclear Plant Accident Clean-Up (Liquidation) and Evacuation

Table 3 presents the collation results of whether the respondents had experience in participating in the clean-up work of the Chernobyl nuclear accident, or in evacuating after the accident.

4.2.1. Liquidators

When asked whether the respondents had worked in the liquidation work of the Chernobyl nuclear plant accident, the great majority (94.4%) responded that they had not, while 2.4% responded that they had been "liquidators." Although these figures suggest that the number of liquidators was quite small, considering that the survey (2018) was conducted 32 years after the accident and many liquidators had since died due to sickness, it is more likely that many people had engaged in liquidation work around the time of the accident.[14] It has been reported that there

14. The average age of the liquidators when working in the cleanup process was approximately 35 years [21]. According to the results of a follow-up

Table 3. Experience in liquidation of nuclear accident and evacuation ($n = 302$).

Item	Answer / Question	Yes	No	Don't remember/ do not know
Liquidator	Did you engage in the clean-up work of the Chernobyl nuclear plant accident?	2.3%	94.4%	3.3%
		7	285	10
Item	Answer / Question	Yes	No	Don't remember/ do not know
Evacuation	Did you evacuate after the Chernobyl nuclear plant accident?	2.0%	96.7%	1.3%
		6	292	4

were 600,000 to 800,000 liquidators in total, of which approximately 200,000 people working there during 1986 and 1987 had received particularly high levels of exposure [21]. The present survey questionnaire did not ask about the specific content of liquidation work; thus we cannot make a simple comparison between the liquidators of the Chernobyl accident and those who worked in the cleanup of the Fukushima Daiichi nuclear plant accident. Still, the results of the present survey suggest that a considerable number of liquidators had been deployed from the Central Federal District to clean up the Chernobyl accident.

4.2.2. Those Who Had Experienced Evacuation

In this study, when asked whether the respondents had experience in evacuation from their homes after the accident, 2.0% responded that they had. In Japan, the number of people who had evacuated from the Evacuation Zone in Fukushima prefecture and resettled elsewhere was 32,631 (as of February 7, 2019), which makes up 1.7% of the total population of Fukushima prefecture. The Chernobyl and Fukushima Daiichi nuclear plant accidents took place in very different settings, and in countries with widely different areas and different designated areas as Evacuation Zones; thus a simple comparison cannot be made between the number of evacuees, and it is reasonable to assume that a considerable number of people residing in the Central Federal District in Russia have had experience in evacuating.

4.3. Memory of Nuclear Plant Accident, Reliability of the Government's Information, and Rapidity of the Government's Response to the Accident

Table 4 presents the collation results of to what extent the respondents remembered the nuclear accident, to what extent they trusted the government-released information about the accident, and whether they felt that the government's response was swift enough.

survey conducted between 1991 and 1998 concerning 65,905 liquidators residing in Russia (with an average exposure dose of 120 mSv), 4,995 (7.6%) died during that period [22]. Incidentally, according to the Ministry of the Environment of Japan, the cumulative number of personnel deployed in the cleanup of the Fukushima Daiichi nuclear plant between January 2012 and March 2017 was approximately 30 million, with a daily maximum of 20,000, while JPY 2.6 billion was spent on work conducted in 111 municipalities across eight prefectures.

4.3.1. Memory of Nuclear Plant Accident

The respondents were asked whether they remembered the fact that the Chernobyl nuclear plant accident had caused a fallout of radionuclides such as cesium-137 on Russian soil. The results showed that 82.5% remembered, which consisted of those who remembered "very well" (52%), and those who remembered "to some extent" (30.5%). When compared with the four other countries, the corresponding figures were 98.2% in Germany, 89.8% in France, 88.0% in Belarus, and 73.1% in Ukraine, indicating that the level of memory among Russians was closest to that of Belarus.

4.3.2. Reliability of the Government-Released Information

When asked whether the respondents felt that the "information released by the Russian (or former Soviet) government (following the Chernobyl accident) could be trusted," those who felt that they could trust it "to some extent" accounted for the largest group (30.8%), followed by those who were "unsure" (28.8%). Meanwhile, 30.1% felt that they could not trust the government, including those who felt that the government "cannot be trusted at all" (12.9%) and those who felt that it "cannot be trusted too much" (17.2%).

When compared with the other four countries, 31.7% of the Belarus group and 25.2% of the Ukraine group responded that they trusted the government-released information "to some extent," while the respondents who responded "yes" (I trust) were more numerous in Russia (10.3%) than in Germany (4.7%) or France (2.7%), but fewer than in Belarus (14.3%).

Therefore, the information released by the Russian government was more or less trusted by those in Belarus, Russia, and Ukraine. It is said that the Russian citizens' assessment of the response to the Chernobyl accident by the governments of the former Soviet Union and the Russian Soviet Federated Socialist Republic (hereafter Russian Republic) was different. As the government of the former Soviet Union attempted to cover up the information for several years after the accident, many citizens of Russia are critical of the leaders of the Central Committee of the Communist Party of the Soviet Union, including Gorbachev. In contrast, the government of the Russian Republic energetically responded to the accident under the leadership of Yeltsin and others, and enacted

Table 4. Memory of Chernobyl accident, reliability of the government-released information, and rapidity and level of satisfaction of the government's response to the accident.

Item	Answer / Question	Very well	To some extent, yes	Cannot say one way or the other	Do not remember well	Do not remember	Mean S.D.
Memory of Chernobyl nuclear accident	Do you remember if Russia was subjected to the fallout of radionuclides such as cesium-137 due to the Chernobyl nuclear plant accident?	52.0%	30.5%	7.0%	6.3%	4.3%	4.195
		157	92	21	19	13	1.093
Item	Answer / Question	Yes	To some extent, yes	Unsure	Cannot be trusted too much	Cannot be trusted at all	Mean S.D.
Reliability of information release by former Soviet government	Do you trust the information released by the Russian government about the Chernobyl nuclear plant accident?	10.3%	30.8%	28.8%	17.2%	12.9%	3.083
		31	93	87	52	39	1.185
Item	Answer / Question	Yes	To some degree	Unsure	Not very swift	No	Mean S.D.
Rapidity of response to accident by Russian government	Do you feel that the Russian government's response to the Chernobyl accident was swift and timely?	20.2%	27.5%	21.2%	16.9%	14.2%	3.225
		61	83	64	51	43	1.333

Notes: The mean represents the average when the responses were scored using a 5-level Likert scale.

the Chernobyl Act before the Soviet government did, although later than the Ukrainian Soviet Socialist Republic [2]. For this reason, the information released by the government of the Russian Federation (which succeeded the Russian Republic) was trusted by the respondents in the Central Federal District more than those in the Western European countries.

4.3.3. Swiftness of the Government's Response to the Accident

In response to the question on whether they felt that "the Russian government's response to the Chernobyl accident was swift," 47.7% felt that it was, including those who completely agreed ("yes" accounted for 20.2%), and those who felt that the response was swift "to some degree" (27.5%). Meanwhile, 31.1% felt that the government response was not swift, including those felt strongly ("no" accounted for 14.2%), and those who felt that it was "not very swift" (16.9%). When comparing Russia with the other four countries, those who felt that the response was swift accounted for 50.4% in Ukraine and 68.7% in Belarus. The respondents in these three countries tended to view the government's response to the accident in a favorable light, which was in agreement with their tendency to trust the Russian Federal government-released information.

4.4. Measures to Deal with the Consequences of the Chernobyl Nuclear Plant Accident, and the Intent of Continuing the Victim's Benefits

Table 5 presents the collation results of the citizens' views on the various measures that deal with the consequences of the Chernobyl accident 32 years since the disaster, and whether they agree on continuing the benefits for the victims.

4.4.1. Decontamination of Contaminated Forests and Fields

It was reported that a forest fire occurred on June 30, 2017 in the vicinity of the Chernobyl nuclear power plant in northern Ukraine [23]. The fire occurred within the Exclusion Zone, which has storage facilities for radioactive waste, and caused the atmospheric radiation dose to rise by 2.5 times the standard level [23]. In this manner, fires in the forests and fields within the vicinity of the nuclear power plant can release the radionuclides that remain in the soil and plants into the atmosphere. Therefore, we asked whether the "contaminated forests and fields should be decontaminated," to which 82.4% responded positively and consisted of those who felt strongly ("yes" accounted for 52.6%), and those who felt so "to some extent" (29.8%).

In Japan, the decontamination of forests and fields includes the removal of contaminated soil or trees, but in Russia, the "dezaktivatsiya" [decontamination] can mean burying the contaminated soil. Although the approach to the decontamination of forests and fields may differ in Japan and Russia, the citizens felt most strongly (agreeing to decontamination) about this issue among the five measures that dealt with the consequences of the Chernobyl accident.

4.4.2. Decontamination of Heavily Contaminated Areas So That Economic Activities Can Be Resumed

Although Novozybkov city in Bryansk oblast is designated as Zone 2, 40,632 people live there as of January, 2016, 30 years after the accident [24]. Therefore, we asked the sample group whether heavily contaminated areas such as Novozybkov should be decontaminated so

Table 5. Various measures to deal with the consequences of the Chernobyl nuclear plant accident, and the continuation of the victim's benefits ($n = 302$).

Evaluated item		Question \ Answer	Yes	To some extent, yes	Cannot say one way or the other	Not so much	No	Mean S.D.
Various measures to deal with the consequences of the Chernobyl nuclear accident.	Decontamination of contaminated forests and fields.	Do you feel that the forests and fields should be decontaminated?	52.6%	29.8%	11.9%	2.6%	3.0%	4.265
			159	90	36	8	9	0.976
	Decontamination of heavily contaminated areas so that economic activities can be resumed.	Do you feel that contaminated areas should be decontaminated so that economic activities can be resumed?	50.0%	31.5%	11.6%	4.0%	3.0%	4.215
			151	95	35	12	9	1.000
	Construction of a nuclear waste processing facility /repository within Exclusion Zone.	Do you feel that processing facilities or repositories of nuclear waste should be constructed in the Exclusion Zone?	13.6%	21.2%	28.5%	16.6%	20.2%	2.914
			41	64	86	50	61	1.314
	Continuation of compensation to liquidators.	Do you feel that the compensation to liquidators should be continued?	43.7%	31.1%	17.2%	4.3%	3.6%	4.070
			132	94	52	13	11	1.053
	Lifting of evacuation directive in contaminated Zones.	Do you feel that the evacuation directive applied to contaminated areas should be lifted if the radiation dose is reduced?	10.3%	35.4%	32.1%	14.2%	7.9%	3.258
			31	107	97	43	24	1.078
Future continuation of benefits to victims.		Do you feel that the benefits for victims should be continued in the future?	50.7%	32.5%	11.3%	3.6%	2.0%	4.262
			153	98	34	11	6	0.937

that economic activities may be resumed, to which 81.5% agreed, including those who felt strongly (50.0%) and those who felt so "to some extent" (31.5%).

The Chernobyl Act is a law designed to provide protection to the Chernobyl victims and contains no provisions that specifically address decontamination, although a clause exists that states that "the cost of decontamination undertaken voluntarily by a company will be compensated from the national budget if certain conditions are met." In Russia, in addition to the decontamination of forests, decontamination can also refer to economic activities in contaminated areas, such as the replacement of contaminated roofs, installation of gas lines to prevent the spread of contamination by wood-burning stoves, or paving roads with asphalt to prevent dust from rising. As mentioned earlier, although the interpretation of decontamination is different and the manner in which heavily contaminated areas are economically restored differs in Japan and Russia, this issue was the second most supported item by the citizens.

4.4.3. Construction of a Nuclear Waste Processing Facility or Repository Within the Exclusion Zone

In the Exclusion Zone established around the accident site, biodiversity has increased and the area has become a paradise for animals.[15] However, there are those who propose making use of the Zone through placement of nuclear waste processing facilities or repositories [27]. When asked whether "processing facilities or repositories of nuclear waste should be constructed in the Exclusion Zone," those who were neutral on the issue accounted for the largest group (28.5%) followed by those who agreed "to some extent" (21.2%), although there were also a fair number who were against it (20.2%).

4.4.4. Continuation of Compensation to Liquidators

Liquidators received medals of honor from the government, and are entitled to receive housing, increased pensions, and free medicines throughout their lives as compensation for the dangerous work they performed [29]. However, because of the continuing economic slump, pensions have been drastically reduced and the liquidators are being asked to pay for their own medical expenses. When asked whether the "compensation to liquidators should be continued," 74.8% replied that it should, and included 43.7% who strongly felt that way, and 31.1% who felt so "to some extent."

4.4.5. Lifting of the Directive to Evacuate from the Contaminated Areas

In October 2015, the Russian government adopted Resolution No. 1074, which reevaluated the contaminated areas and lowered the designated contamination levels of many contaminated areas in Bryansk Oblast, including the reclassification of Novozybkov from Zone 2 to Zone 3 [24]. In Bryansk oblast, the designated contamination level of 220 settlements was lowered, and after desig-

15. The Exclusion Zone is inhabited by elk, beavers, owls, and many rare species, including grizzly bears, lynx, and wolves, which were rarely found in this area previously [25]. Although the radioactive dose is high in the Exclusion Zone, animal populations are rising since they are not threatened from hunting or habitat destruction by humans [25]. However, studies that have subjected populations of plants, fish, amphibians, and mammals to morphogenetic, cytogenetic, or immunological tests have found impairments among all populations [26].

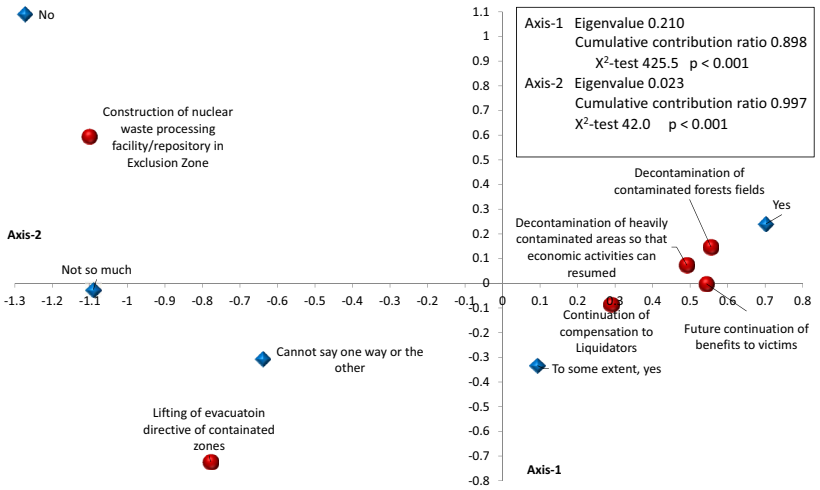

Fig. 2. Relationship between the continuation of the victim's benefits and the future measures dealing with Chernobyl consequences. Source: Based on the survey results from SurveyMonkey.

nation of affected areas was lowered, designation of contaminated areas was removed from 40 settlements with the lowest level (Zone 4) [28]. When asked whether the "evacuation directive in the contaminated Zones should be lifted if the radiation dose falls," those who agreed "to some extent" accounted for the largest group (35.4%), followed by those were neutral on the issue (32.1%).

4.4.6. Intent to Continue the Benefits for Victims in the Future

The government has drastically reduced its benefits to the Chernobyl victims in Bryansk Oblast where the contamination designation has been lowered. With the redesignation, various benefits were reduced, and a group of victims filed suits with the Supreme Court [28]. When asked whether the "benefits to the victims should be continued," 83.2% felt that it should; this proportion consisted of those who felt strongly (50.7%) and those who felt so "to some extent" (32.5%).

4.4.7. Relationship Between the Continuation of Benefits and the Future Measures for Dealing with the Consequences of the Chernobyl Accident

To visualize how the benefits to victims (which are supported by the citizens of the Central Federal District) are positioned in relation to the measures that deal with the consequences of the Chernobyl accident, we performed a correspondence analysis. This analysis allows the visualization of the relationship between categories on a map. Categories that are close together on the map are strongly related, while those apart are weakly related.

Figure 2 shows the analysis results of the relation between the citizens' views on the continuation of the victim's benefits and the future measures to deal with the Chernobyl consequences. The plots fall in the range between 1.1 and -0.8 on the ordinate (axis-1) and between 0.8 and -1.3 on the abscissa (axis-2), so that the two scales display a similar assessment range. The cumulative contribution ratios are 89.8% for axis-1 alone and 99.7% when axis-2 is included, and the p values of the chi-square test (test of the significance level of differences between rows, between columns, and of the residuals) for axis-1 and -2 are lower than 1%, indicating that the two axes are statistically significant. Axis-1 can be interpreted as representing the measures called for by the citizens, and axis-2 as the assessment levels of the measures.

The first quadrant contains the "decontamination of contaminated forests and fields"; "decontamination of heavily contaminated areas so that economic activities can be resumed"; and "future continuation of benefits to the victims," and those in their vicinity answered "yes" (i.e., strongly agree). The second quadrant contains the "construction of a nuclear waste processing facility/repository in the Exclusion Zone" and is proximate to "no" (i.e., strongly disagree). The third quadrant contains the "lifting of the evacuation directive in the contaminated Zones," and is proximate to "cannot say one way or the other." The fourth quadrant contains the "continuation of compensation to the liquidators" and is proximate to "to some extent, yes." In sum, the analysis results indicated that the citizens of the Central Federal District were in favor of continuing the benefits to the victims, alongside the decontamination of contaminated forests, fields, and habitable zones.

4.5. Compensation and Benefits That Should Be Continued in the Future, and the Implemented Organizations

In this section, we examine the type of organization or group from which the citizens wished to receive compensation or benefits when a nuclear plant accident occurs, and the type of compensation or benefits they wished to receive.

Table 6. Organization that provides compensation or benefits in the event of nuclear plant accident (multiple answers allowed).

Organization	Frequency	Percentage
State	281	93.0%
Federal District	153	50.7%
City	136	45.0%
Oblast	124	41.1%
International NGO	60	19.9%
Private company	45	14.9%
Non-profit organization	29	9.6%
Citizen or individual	19	6.3%
Other	3	1.0%

4.5.1. Organizations That Provide Compensation or Benefits When a Nuclear Plant Accident Occurs

Table 6 presents the collation results of the types of organization from which citizens wished to receive compensation or benefits in the event of a nuclear plant accident. The respondents most wished to receive compensation or benefits from the State (93.0%). This was followed by the Federal District (50.7%), the city of Moscow (45.0%), and the Oblast (41.1%), which shows their preference for higher-level administrative units within the Federation when receiving compensation or benefits.[16] Meanwhile, not many wished to receive compensation or benefits from international NGOs (19.9%), private companies (14.9%), or non-profit organizations (9.6%), and very few from individuals (6.3%). In Japan, the Tokyo Electric Power Company (TEPCO) shoulders the liability of paying out compensation for nuclear damage resulting from the Fukushima Daiichi accident [30]. According to Omatsu [8], the responsibility for the nuclear plant accident was borne by TEPCO because it was the private operator of the Fukushima Daiichi nuclear power plant. However, the Chernobyl plant was State-operated, which provides legal grounds for the State's obligation to pay compensation for the consequences of the Chernobyl accident. Yet, Baba and Omatsu [2] stressed that it was not because the plant was State-run that the State assumed responsibility, but because it recognized its responsibility to protect the health and living conditions of its subjects. In the same vein, Baba and Omatsu [2] argued that the issue of whether the plant is State or privately operated has no bearing on the consequences of the accident. The prevailing view in Japan is that any compensation for an accident that occurred at a privately-run nuclear power plant should be borne by the utility company (TEPCO), which will pay from revenues earned from utility bills, and the role of the State is unclear. In Russia, although it is said that the Chernobyl Act has become a dead letter, the citizens expected to receive compensation or benefits from the State rather than from private companies.

16. In the sample group considered in this paper, the only city is Moscow.

Table 7. Compensations and benefits that should be continued in the future (multiple answers allowed).

Type of compensation or benefits	Frequency	Percentage
Free medicine	244	80.8%
Early provision of pension	240	79.5%
Free medical examinations	238	78.8%
Subsidized utility bill (electricity, gas, etc.)	191	63.2%
Free vouchers to sanatoriums	167	55.3%
Compensation of lost property	163	54.0%
Free pass to public transportation	157	52.0%
Additions to monthly salary	149	49.3%
Additional paid vacations	146	48.3%
Compensation for children born after Chernobyl accident	138	45.7%
Social welfare	126	41.7%
Right to housing	118	39.1%
Provision of health improvement holidays tickets	107	35.4%
Compensation for moving expenses	107	35.4%
Employment and housing at resettled location	101	33.4%
Right of resettlement	98	32.5%
Free school lunch	78	25.8%
Distribution of uncontaminated food	53	17.5%
Rent subsidy	50	16.6%
Preferential treatment to university enrollment	37	12.3%
Other	3	1.0%

4.5.2. Compensation and Benefits as Stipulated by the Chernobyl Act

Table 7 presents the types of compensation and benefits that the respondents felt should be continued in the future. With regard to these compensations and benefits, the Chernobyl Act stipulates that the "State is liable for protecting the lives and health of victims across generations and continuing compensation for the damages [31]." The table shows that the citizens mostly favored "free medicines" (80.8%), followed by the "early provision of a pension" (79.5%), and "free medical examinations" (78.8%). In addition, over half of the citizens wished for the continuation of a "subsidized utility bill" (63.2%), "free vouchers to sanatoriums" (55.3%), the "compensation of lost property" (54.0%), and "free passes for public transportation" (52.0%). It is thought that the citizens were favorable to the continuation of these compensations and benefits since they are directly connected to the lives of the victims.

4.6. Levels of Satisfaction with the Russian Government's Response to the Chernobyl Accident, and Measures Necessary for the Reconstruction and Social and Economic Progress of the Affected Areas

4.6.1. Levels of Satisfaction with the Russian Government's Response to the Chernobyl Accident

Table 8 presents the collation results of the levels of satisfaction among the citizens regarding the Russian gov-

Table 8. Level of satisfaction from the Russian government's response to the Chernobyl accident ($n = 302$).

Item	Answer / Question	Very satisfied	Satisfied to some extent	Cannot say one way or the other	Not so satisfied	Not satisfied at all	Don't remember/ unborn at the time	Mean S.D.
Level of satisfaction with government response to Chernobyl accident.	Are you satisfied with the Russian government's response following the Chernobyl nuclear plant accident?	14.9%	25.2%	15.6%	15.6%	16.2%	12.6%	3.080
		45	76	47	47	49	38	1.375

Notes: The mean and S.D. are computed from the responses of "very satisfied" to "not satisfied at all," and scored according to a 5-level Likert scale.

Table 9. Measures necessary to achieve social and economic progress in affected areas (multiple answers allowed).

Measure	Frequency	Percentage
Continued observation of health status of victims of nuclear plant accident	221	73.2%
Continuation of decontamination and radiation protection measures in habitation areas where the annual average effective radiation dose may exceed 1 mSv	202	66.9%
Continuation of radioactivity inspection and monitoring	189	62.6%
Improved information disclosure and educational activities for residents of contaminated areas	160	53.0%
Adopt international standards in radionuclide regulation	143	47.4%
Continue provision of free meals, health improvement measures and sanatorium treatments to children	138	45.7%
Provide company housing or housing to citizens designated for preferential treatment under Chernobyl Act	127	42.1%
Concentrate research resources and funds to continue scientific support	114	37.7%
Other	3	1.0%

ernment's response to the Chernobyl accident. The results show that those who were "satisfied to some extent" (25.2%) were the most numerous, followed by those who were "not satisfied at all" (16.2%) and those who were both "not so satisfied" and "cannot say one way or the other" (15.6% each). There was also a fair number of those who were "very satisfied" (14.9%). The satisfied accounted for 40%, which indicates that the Russian Federal government's response to the accident was viewed more favorably when compared to that of the former Soviet government immediately after the accident.

4.6.2. Strategy for the Advancement of Affected Areas as Based on the Chernobyl Act

Table 9 presents the measures considered as necessary to achieve social and economic progress within the affected areas. They represent eight measures selected from the most urgent issues targeted for 2020 as listed in the development strategy (for 2011–2015) for the affected areas as based on the Chernobyl Act [32].

The "continued observation of the health status of the victims of the nuclear plant accident" (73.2%) was the measure chosen by the most respondents to be necessary. Following the nuclear accident, many victims were affected by disorders of the digestive and respiratory systems [16, 32]. Therefore, the respondents felt the need to continue the observation of the health status of the Chernobyl victims.

This was followed by measures regarding radiation protection, such as the "continuation of decontamination and radiation protection measures in habitation areas where the annual average effective radiation dose may exceed 1 mSv" (66.9%) and the "continuation of radioactivity inspection and monitoring" (62.6%).

The "improved disclosure of information and educational activities for residents of the contaminated areas" accounted for 53.0%, and is related to the "reliability of the information release by the former Soviet government" (see **Table 4**), which also ranked relatively highly. This reflects the feeling among the citizens that the provision of information and educational activities needed to be improved, since information of the accident had been withheld at the time of the accident, and it was only in the spring of 1989 (after the democratization movement in the Soviet Union) that the contamination map of cesium-137 was disclosed.

The other measures were, in descending order, to "adopt international standards in radionuclide regulation" (47.4%); to "continue the provision of free meals, health improvement measures, and sanatorium treatments to children" (45.7%); to "provide company housing or housing to citizens designated for preferential treatment under the Chernobyl Act" (42.1%); and to "concentrate the research resources and funds to continue scientific support" (37.7%).

While policies exist in Russia to improve living conditions, such as the infrastructure improvement of the areas where the Chernobyl victims reside, the Chernobyl Act is designed as legislation to provide compensation and benefits to victims on an "individual basis" and does not specifically address the reconstruction of affected areas. Although the "reconstruction" of the nation and its affected areas was given priority in Japan after the March 2011 earthquake/tsunami and the Fukushima nuclear plant accident, in Russia the "provision of relief to individual victims," such as the observation of the health status, radiation checks, and monitoring of the victims, was given priority. Despite the fact that the benefits to

the evacuees who had resettled from the affected areas to other locations have been slack in some cases in Japan,[17] the Chernobyl Act places a higher priority on the "relief of individual victims" than on the "reconstruction of the areas."

5. Regression Analysis and Results of Citizen Satisfaction Regarding Benefits and Compensation as Stipulated in the Chernobyl Act, and Their Views on its Continuation

In this Section, we applied the ordinal logit model to examine how the citizens' assessments were affected by individual attributes, and the items being assessed. This method can be applied when the explained variables may be expressed by ordinal numbers. We then discuss how the Russian citizens assessed the strategies for advancement as based on the Chernobyl Act, and the compensation and benefits as stipulated by the Act.

5.1. Method of Analysis

5.1.1. Analysis of the Memory of the Chernobyl Nuclear Plant Accident, the Swiftness of the Russian Government's Response to the Accident, and the Various Measures to Deal with the Consequences

We first performed an analysis where the objective variables consisted of the "memory of the Chernobyl nuclear accident," the "reliability of the information release by the former Soviet government," the "rapidity of the response to the accident by the Russian government" (see **Table 4**); and the "various measures to deal with the consequences of the Chernobyl nuclear accident" (see **Table 5**). The objective variables are scored as 1 = "do not remember," 2 = "do not remember well," 3 = "cannot say one way or the other," 4 = "to some extent," and 5 = "very well" (see **Tables 4** and **5**).

Only the individual attributes were used as explanatory variables. This reasoning was due to allowing comparisons with the survey results of the five countries of Germany, France, Finland, Ukraine, and Belarus.

As explanatory variables of the individual attributes, the following three qualitative (dummy) variables were selected: Sex (male = 1, female = 0), area of residence (city of Moscow = 1, other area = 0), and presence of a child aged 12 or under (yes = 1, no = 0).

In addition, four continuous variables were selected: age, number of household members, educational background, and income (average income). For age and income, the class values of each category were determined and used as discrete variables: for example, 45 for age "40–50," and RUB 85,000 for income "RUB 80,001–90,000." The educational backgrounds were assigned scores from high school = 1, to graduate school = 4, and were used as discrete variables for the explanatory variables.[18]

When collating the results, the categories of the dependent variables were merged when adjacent categories did not display a statistically significant difference, or when a category contained an insufficient number of respondents. Only the optimal estimation results are given as based on Akaike's Information Criteria (AIC) or likelihood ratios.

In the table, "cut" denotes a threshold variable and is used as follows: $Pr\ (y = 1) = Pr\ (\beta x < \text{cut1})$ and $Pr\ (y = 2) = Pr\ (\text{cut1} < \beta x < \text{cut2})$, where y represents a dependent variable category, x an explanatory variable, and β a parameter.

5.1.2. Analysis of the Relationship Between the Levels of Satisfaction with the Russian Government's Response to the Accident and the Development Strategy of Affected Areas as Based on the Chernobyl Act

Next, we used the ordinal logit model to estimate the levels of satisfaction among Russian citizens regarding the government's response to the Chernobyl accident, and to what extent this was affected by the measures adopted as development strategies of the affected areas as based on the Chernobyl Act (see **Table 9**). We then used the model to estimate the threshold effect.

As the objective variable, we used the "level of satisfaction with the Russian government's response to the Chernobyl accident," where 1 = "not satisfied at all," 2 = "not so satisfied," 3 = "cannot say one way or the other," 4 = "satisfied to some extent," and 5 = "very satisfied." Since the responses included "do not remember/unborn at the time" (see **Table 8**), these 38 responses were removed to make the sample number total 264.

As explanatory variables, we used the individual attributes used in the previous section and the development strategies for the affected areas as based on the Chernobyl Act. Using the backward selection method, explanatory variables with significance levels of 20% or higher were removed, and estimation was performed so that optimal results were obtained where only variables with significance levels of 1–10% remained.

5.1.3. Analysis of the Relationship Between the Opinions of the Victim's Future Continuation of Benefits and the Compensation and Benefits as Stipulated by the Chernobyl Act

Finally, we used the ordinal logit method to estimate whether the citizens wished the benefits to continue to the victims in the future, to what extent this was affected by

17. In consideration of the fact that the support of the evacuees that have moved from the affected areas has slackened, the Science Council of Japan [33] has proposed the establishment of a system to allow the evacuees to retain connections with the local governments of both their former residences and resettled locations, so as to respect the victims choices of returning to their former homes or resettling elsewhere as a proposal on the resident status of evacuees in the Great East Japan Earthquake and Fukushima Daiichi nuclear plant accident.

18. It is also possible to divide the sample group into dummies of graduates of high school, two-year colleges, university, and graduate schools, but here we employ the discrete variables based on scores as the substitute variables of educational years.

Table 10. Memory of the Chernobyl nuclear plant accident, the swiftness of the Russian government's response to the accident, and the decontamination of forests and fields according to individual attributes.

Variable	Memory of Chernobyl nuclear plant accident				Swiftness of Russian government response to accident				Decontamination of forests and fields			
	Coefficient	S.D.	p value		Coefficient	S.D.	p value		Coefficient	S.D.	p value	
Male=1	0.334	0.252	0.185		-0.604	0.250	0.016	**	-0.628	0.245	0.010	**
Average age	0.055	0.013	0.000	***	0.018	0.012	0.151		0.007	0.012	0.579	
Moscow city=1	-0.022	0.246	0.929		-0.520	0.241	0.031	**	-0.144	0.238	0.545	
No. of household members	-0.178	0.117	0.128		0.072	0.119	0.542		-0.005	0.117	0.968	
With child=1	0.279	0.275	0.310		0.519	0.271	0.055	*	0.369	0.271	0.173	
Educational background	0.287	0.151	0.057	*	-0.359	0.145	0.013	**	0.139	0.146	0.341	
Average income	0.005	0.003	0.125		0.000	0.003	0.963		0.003	0.003	0.318	
cut1	-1.298	0.782	0.097	*	0.242	0.749	0.746		0.918	0.744	0.217	
cut2	-2.910	0.796	0.000	***	-1.110	0.753	0.140		-0.574	0.742	0.439	
Likelihood ratio	570.7	***			593.0	***			592.7	*		
AIC	588.7				611.0				610.7			
χ^2	37.8				21.2				13.6			
McFaddenR^2	0.062				0.035				0.022			

Notes:
(1) ***, **, and * denote statistical significance levels of 1, 5, and 10% respectively (the same is for **Table 11**).
(2) "Cut" denotes thresholds. In the case of the "memory of Chernobyl accident," cut1 represents the range from "do not remember" to "cannot say one way or the other," and cut2 represents "to some extent, yes."
(3) In the case of the "swiftness of the Russian government's response to the accident," cut1 represents the combined groups of "no," "not very swift," and "unsure," while cut2 represents "to some degree."
(4) In the case of the "decontamination of contaminated forests and fields," cut1 represents the combined groups of "no" to "cannot say one way or the other," and cut2 represents "to some extent, yes."

the compensations and benefits as stipulated by the Chernobyl Act (see **Table 7**), and to determine the threshold effect.

As the objective variable, we used the "views on the future continuation of benefits to the victims," where 1 = "no," 2 = "not so much," 3 = "cannot say one way or the other," 4 = "to some extent, yes," and 5 = "yes."

As the explanatory variables, we used the compensation and benefits as stipulated by Chernobyl Act. The explanatory variables with significance levels of 20% or higher were removed.

5.2. Estimation Results

5.2.1. Estimation Results of the Memory of the Chernobyl Nuclear Plant Accident, the Swiftness of the Russian Government's Response, and the Various Measures to Deal with the Consequences

Table 10 presents the results for the memory of the Chernobyl nuclear plant accident, the swiftness of the Russian government's response to the accident, and the various measures to deal with the consequences of the Chernobyl accident. Although the pseudo R^2 is low and lies in the range of 0.022–0.062, the likelihood ratio tests that accept the null hypothesis of the regression coefficient being equal to zero have been removed from the table's model.[19]

In the example of the "memory of the Chernobyl nuclear accident" (see **Table 4**), the survey responses are divided into five categories ranging from "do not remember" to "very well," yet the categories for "do not remember," "do not remember well," and "cannot say one way or the other" were merged since they did not display statistically significant differences. The threshold effect is not discussed here because of spatial limitations.

In the results for the "memory of the Chernobyl nuclear accident," the coefficient for age (0.055) was positive, indicating that the higher the age, the more they remembered the accident. In the cases of Germany, France, Ukraine, and Belarus, those of older ages remembered the accident well [11, 12, 14, 15]. Further, the coefficient for the educational background (0.287) was also positive, indicating that those who were more educated remembered the accident; this trend was also observed in Finland [13].[20]

Next, those who felt that the "Russian government's response to the accident was swift" tended to be women (−0.64), while the men did not feel that way. In contrast, the men felt that the response to the accident was swift in Ukraine [14], which displayed a different pattern from

19. Although analysis was also performed with the objective variables of the "reliability of the information released by the former Soviet government" (see **Table 4**), the "decontamination of heavily contaminated areas so that economic activities can be resumed"; the "construction of a nuclear waste processing facility/repository within the Exclusion Zone"; the "continuation of compensation to liquidators"; and the "lifting of the evacuation directive of contaminated Zones" (see **Table 5**) are omitted as based on the results of the likelihood ratio test (LR-test).

20. In Sweden, the Swedish National Food Agency certifies the food items that have radioactivity levels below the permissible levels. It has been reported that the citizens in Sweden that purchase certified food items are those with higher educational backgrounds [34].

Russia. Further, those who do not reside in the city of Moscow (−0.520) tended to feel that the government's response was not swift. In Ukraine and Belarus, residents of the western regions where radiation contamination was low had felt that the government's response was slow [14, 15]. The coefficient for the educational background (−0.359) was also negative, indicating that those with less education tended to feel that the government's response was slow, which displayed a similar trend with Belarus [15].

Further, those who felt that the "forests and fields should be decontaminated" tended to be women (−0.628). In Belarus, the women were unsatisfied with the safety measures within forestry that were implemented by the government [15]. Although it is not possible to make a clear judgment as the questions were framed differently, it may be that women tend to have a higher environmental awareness regarding the forests.

In sum, the comparison of the survey results of six countries, including Russia, showed that statistically significant differences were found in the respondents of older ages who remembered the Chernobyl accident, and in the greater distances from the Chernobyl plant where the level of radiation contamination was low, and in the residences of those who felt that the Russian government's response to the accident was not swift.

5.2.2. Estimation Results of the Relationship Between the Levels of Satisfaction from the Russian Government's Response and the Development Strategies for the Affected Areas as Based on the Chernobyl Act

Table 11 presents the results of the relationship between the levels of satisfaction with the Russian government's response to the accident and the development strategies for the affected areas as based on the Chernobyl Act. The "cuts" in the Table are divided into cut1 (not satisfied at all), cut2 (not so satisfied), and so on, in reference to cut5 (very satisfied).

Those who were "satisfied with the Russian government's response to the accident" tended to have a child (0.429), while the men (−0.594) were not satisfied. The "provision of company housing or housing to citizens designated for preferential treatment under the Chernobyl Act" (−0.430) was negatively related to the satisfaction level.

Next, five threshold effects from "not satisfied at all" to "very satisfied" were estimated.

The results for men indicated positive values for "not satisfied at all" (0.089) and "not so satisfied" (0.048), but indicated negative values with large magnitudes of those that were "satisfied to some extent" (−0.066) and "very satisfied" (−0.080), indicating that they were generally unsatisfied. Meanwhile, those with children displayed negative values for "not satisfied at all" (−0.064) and "not so satisfied" (0.035), but had large positive values for "satisfied to some extent" (0.048) and "very satisfied" (0.058), indicating that they were generally satisfied.

Meanwhile, the "provision of company housing or housing to citizens designated for preferential treatment under the Chernobyl Act" displayed positive values for "not satisfied at all" (0.064) and "not so satisfied" (0.035), and negative values with large magnitudes for those that were "satisfied to some extent" (−0.066) and "very satisfied" (−0.080), which indicates that this measure was related to the dissatisfaction with the Russian government's response to the accident.

Therefore, the households with children tended to be satisfied with the Russian government's response to the accident. The greatest benefit as based on the Chernobyl Act lies in the provision of a maximum of double the amount of child allowance, which may help to explain this finding.

5.2.3. Estimation Results of the Relationship Between Views on the Future Continuation of Victim's Benefits and the Compensations and Benefits as Stipulated by the Chernobyl Act

Table 12 presents the results of the relationship between the future continuation of benefits to the victims and the compensations and benefits as stipulated by the Chernobyl Act. The "cuts" in the Table are divided into cut1 (no), cut2 (not so much), and so on, in reference to cut5 (yes).

Those who felt that the "benefits to the victims should be continued into the future" tended to be those with children (0.589). The coefficients for the "right of resettlement" (0.571), "early provision of a pension" (1.121), and "free medicines" (0.803) were also positive, indicating that the citizens favored the continuation of these benefits.

Next, five threshold effects between "yes" and "no" were evaluated.

Those with children displayed negative coefficients for "no" (−0.007), "not so much" (−0.014), and "cannot say one way or the other" (−0.046). Although "to some extent, yes" (−0.079) was negative as well, "yes" (0.146) displayed a large positive value. Therefore, these citizens appeared to favor the continuation of benefits to the victims.

The "right of resettlement" had negative coefficients from "no" (−0.006) to "to some extent, yes" (−0.083), but displayed a large positive value for "yes" (0.141). The "early provision of a pension" (0.266) and "free medicines" (0.195) also displayed large positive values for "yes." Thus, the citizens appeared to favor continuing the "right of resettlement," the "early provision of a pension," and "free medicines."

Finally, the "compensation for lost property" displayed a large positive value for "yes" (0.104), indicating that the citizens were in favor of continuing this compensation, although the regression coefficient did not display a statistical significance. However, the responses to a "rent subsidy" were divided between "no" (0.007) and "to some extent, yes" (0.066), indicating that the citizens were divided in their views against discount benefits. It was also found

Table 11. Estimation results of the relationship between the levels of satisfaction from the Russian government's response to the accident and the development strategies for affected areas as based on the Chernobyl Act.

Variable	Level of satisfaction with government response to Chernobyl accident				Not satisfied at all			Not so satisfied			Cannot say one way or the other			Satisfied to some extent			Very satisfied		
	Coefficient	S.D.	p value		dy/dx	S.D.		dy/dx	S.D.		dy/dx	S.D.		dy/dx	S.D.		dy/dx	S.D.	
Provision of company housing or housing	-0.430	0.225	0.056	*	0.064	0.035	*	0.035	0.019	*	0.006	0.005		-0.049	0.027	*	-0.057	0.030	*
Male=1	-0.594	0.223	0.008	***	0.089	0.035	**	0.048	0.019	***	0.009	0.007		-0.066	0.026	**	-0.080	0.030	***
With child=1	0.429	0.224	0.055	*	-0.064	0.034	*	-0.035	0.019	*	-0.007	0.005		0.048	0.026	*	0.058	0.030	*
cut1	-1.736	0.254	0.000	***															
cut2	-0.788	0.234	0.001	***															
cut3	-0.039	0.231	0.869																
cut4	1.429	0.252	0.000	***															
Likelihood ratio	-410.9	***																	
AIC	835.9																		
χ^2	16.1																		
Pseudo (McFadden) R^2	0.019																		

Notes:
(1) Although the regression equation contains seven individual attributes and development strategies for the affected areas as based on the Chernobyl Act, the backward selection method is used to remove explanatory variables with significance levels of 20% or greater, and optimal results are estimated so that variables with significance levels of 1–10% remain.
(2) For the "level of satisfaction with the Russian government's response to the accident," the thresholds consist of cut1 (not satisfied at all) up to cut4 (satisfied to some extent), with reference to cut5 (very satisfied).

Table 12. Estimation results of the relationship between views on the future continuation of benefits to the victims and the compensations and benefits as stipulated by the Chernobyl Act.

Variable	Future continuation of benefits to victims				No			Not so much			Cannot say one way or the other			To some extent, yes			Yes		
	Coefficient	S.D.	p value		dy/dx	S.D.		dy/dx	S.D.		dy/dx	S.D.		dy/dx	S.D.		dy/dx	S.D.	
Free vouchers to sanatoriums	0.425	0.278	0.126		-0.004	0.003		-0.009	0.006		-0.032	0.020		-0.061	0.041		0.106	0.069	
Compensation for children born after Chernobyl accident	0.378	0.250	0.130		-0.004	0.003		-0.008	0.006		-0.029	0.019		-0.053	0.036		0.094	0.062	
Right of resettlement	0.571	0.281	0.042	**	-0.006	0.003	*	-0.012	0.006	*	-0.041	0.020	**	-0.083	0.043	*	0.141	0.068	**
Early provision of pension	1.121	0.310	0.000	***	-0.018	0.009	*	-0.035	0.016	**	-0.105	0.037	***	-0.109	0.025	***	0.266	0.066	***
Rent subsidy	-0.555	0.356	0.118		0.007	0.006	*	0.015	0.012		0.048	0.035		0.066	0.036	*	-0.137	0.085	
Free medicine	0.803	0.324	0.013	**	-0.011	0.007		-0.023	0.013	*	-0.072	0.035	**	-0.089	0.028	***	0.195	0.074	***
Additional paid vacations	0.399	0.254	0.116		-0.004	0.003		-0.009	0.006		-0.031	0.020		-0.056	0.036		0.099	0.063	
Compensation for lost property	0.417	0.254	0.100		-0.005	0.003		-0.009	0.006		-0.033	0.020		-0.057	0.035		0.104	0.063	*
Male=1	-0.312	0.241	0.195		0.003	0.003		0.007	0.006		0.024	0.019		0.043	0.033		-0.078	0.060	
With child=1	0.589	0.235	0.012	**	-0.007	0.004	*	-0.014	0.007	**	-0.046	0.020	**	-0.079	0.032	**	0.146	0.057	**
Educational background	-0.229	0.153	0.133		0.002	0.002		0.005	0.004		0.018	0.012		0.032	0.022		-0.057	0.038	
cut1	-2.611	0.651	0.000	**															
cut2	-1.446	0.566	0.078	*															
cut3	-0.041	0.540	0.117																
cut4	1.903	0.553	0.000	***															
Likelihood ratio	-308.6	***																	
AIC	647.4																		
χ^2	80.0																		
Pseudo (McFadden) R^2	0.115																		

Notes:
(1) Although the regression equation contains seven individual attributes and compensations and benefits as stipulated by the Chernobyl Act, the backward selection method is used to remove explanatory variables with significance levels of 20% or greater, and optimal results are estimated so that variables with significance levels of 1–10% remain.
(2) For the "future continuation of benefits to the victims," the thresholds consist of cut1 ("no") up to cut4 ("to some extent, yes"), with reference to cut5 ("yes").

in the previous section on the "level of satisfaction with the Russian government's response to the accident" that there was dissatisfaction with respect to the "provision of company housing or housing to citizens designated for preferential treatment under the Chernobyl Act." In fact, in Novozybkov, the radioactive exposure dose fell, and

the designated contamination level was lowered, which resulted in various benefits being reexamined and revised. Therefore, it was found that among the benefits to victims, the citizens were agreeable to the right of resettlement, the early provision of a pension, and free medicines, but divided on the issues of the provision of housing and rent subsidies.

6. Conclusion

6.1. Discussion

In this case study for the Central Federal District of Russia, we performed a statistical analysis on the extent to which the citizens were satisfied with the benefits and compensations as stipulated by the Chernobyl Act, and their views on continuing those benefits and compensations. The following findings were obtained.

First, in the Chernobyl Act of Russia, the affected areas are classified into four Zones depending on the contamination levels (Zone 1 to Zone 4). This law provides protection to a wide range of victims, and assumes that the consequences will last for an extended period. It clearly sets forth the principle that the responsibility of providing compensation for the adverse consequences of the accident lies in the State, and stipulates the benefits that the liquidators and evacuees are entitled to receive.

Next, among the sampled population, one out of 40 had engaged in the cleanup work (i.e., liquidation) of the Chernobyl accident, while one out of 50 had experienced evacuation or resettlement. While over 80% of the surveyed citizens remembered the Chernobyl accident, Russian citizens tended to place trust in the information that had been released by the government, and believed that the government had acted swiftly, in comparison to citizens of Western European countries. They also felt that the decontamination efforts of the contaminated forests and fields, the decontamination of heavily contaminated areas, and the compensation to liquidators should be continued.

Further, the number of those who were satisfied with the Russian government's response to the accident slightly exceeded the number of those who were unsatisfied. The continued observation of the health status of the victims and the continued radiation protection measures ranked high as measures regarded as necessary to speed up reconstruction and the social and economic recovery of the affected areas. The results of the ordinal logit model showed that those with children (who are given preferential treatment by the Chernobyl Act) and women were generally satisfied with the Russian government's response to the accident. However, many citizens were unfavorable toward the provision of company housing or housing to the victims who were preferentially treated by the Chernobyl Act.

In addition, over 80% of the surveyed citizens favored the continuation of benefits to the victims, and this trend was more pronounced among those with children. Further, the citizens favored the continuation of such benefits as the right of resettlement, the early provision of a pension, and free medicines in particular, but many were against the provision of preferential treatment for rent.

6.2. Future Issues

When designing the survey, the hypothesis we made ("The level of satisfaction among citizens is low regarding the benefits and compensations as stipulated by the Chernobyl Act") was disproved, and it was found that the citizens' general levels of satisfaction was high. This may be because the survey's sample group consisted mostly of residents from Moscow and its vicinity, and the populations of those who had resettled from areas affected by the Chernobyl accident, and those who had engaged in the cleanup work were relatively small. The citizens' levels of satisfaction may have been low if the survey had targeted the southwestern part of the Bryansk region where the contamination level was high, or the city of Novozybkov, where information regarding contamination had been withheld immediately after the catastrophe. Further, if the survey had targeted Saint Petersburg (from which a large number of liquidators had been dispatched), the liquidators and their families would have made up a larger share of the sample, thus changing the attribution composition considerably. In this study, we were only able to limit the survey scope to a SurveyMonkey consumer panel for the Central Federal District. Thus, we admit that there are issues with the selection of the target area in the present survey. Yet, the results are noteworthy in that the residents of Moscow and its vicinity (where there are not many victims, and which are far from the affected areas) still remember Chernobyl more than thirty years on, and feel the necessity of health examinations or measures that place emphasis on children. However, another finding was that there are those who feel negatively about the preferential treatment as stipulated by the Chernobyl Act. To follow up on this study, we plan to design another survey where the target area is limited to Bryansk Oblast or Saint Petersburg, and to examine the views among residents.

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Selected Publications:
• Y. Yano, T. Nakamura, and A. Maruyama, "Factors influencing the level of anxiety toward vegetables grown in plant factories using artificial light: A case of JA farmers' market in Fukushima," J. of Rural Problems, Vol.52, Issue 4, pp. 235-240, 2016.
• Y. Yano, D. Blandford, A. Maruyama, and T. Nakamura, "Consumer perceptions of fresh leafy vegetables in Japan: An application of word co-occurrence network analysis," British Food J., Vol.120, Issue 11, pp. 2554-2568, 2018.
• Y. Yano, E. Kato, Y. Ohe, and D. Blandford, "Examining the opinions of potential consumers about plant-derived cosmetics: An approach combining word association, co-occurrence network, and multivariate probit analysis," J. of Sensory Studies, Vol.34, Issue 2, e12484, 2019.

Academic Societies & Scientific Organizations:
• Agricultural Economics Society of Japan (AESJ)
• Association for Regional Agricultural and Forestry Economics (ARAFE)
• Food System Research Association of Japan (FSRAJ)
• Japanese Society of Regional and Agricultural Development (JASRAD)