

Lessons from Fukushima: Rethinking Population Risk and Evacuation Planning near Nuclear Facilities in Japan

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Abstract

This study investigates the population distribution surrounding nuclear power plant sites in Japan, focusing on the extent to which evacuation zones encompass resident populations in the event of a nuclear emergency. By analyzing spatial demographic data across multiple census years, the research aims to identify patterns and variations in population density within defined distance buffers around nuclear facilities. The findings reveal significant differences among regions, underscoring the limitations of uniform, radius-based evacuation policies. This spatially grounded demographic analysis contributes to the growing body of literature on nuclear disaster preparedness and highlights the need for more adaptive, evidence-based risk management strategies in the siting and operation of nuclear power plants.

Keyword: Fukushima nuclear disaster, Evacuation planning, Population distribution, Risk management, PAZ and UPZ zones

1. Introduction

1.1 The Evolving Relationship between Evacuation and Decontamination in the Fukushima Nuclear Disaster

The hydrogen explosions at the Fukushima Daiichi Nuclear Power Plant in March 2011 triggered widespread radioactive contamination, affecting both the atmosphere and soil. Radiation dose zones, ranging from low to high—extended far beyond the original Emergency Planning Zone (EPZ), which had been set at an 8–10 km radius. These unanticipated spatial patterns forced a reevaluation of regional nuclear emergency preparedness plans.

Although the complete extent of contamination remains uncertain, approximate levels have been estimated using fixed radiation monitoring stations and soil contamination maps produced by the Nuclear Regulation Authority's Radiation Monitoring Information Sharing and Publication System. Based on these data, areas with estimated annual exposure above 20 mSv were designated as evacuation zones—typically within 20 km of the plant, though some municipalities like Iitate village lay beyond this boundary.

Since 2011, the Japanese government, led by the Ministry of the Environment, has promoted decontamination projects aimed at reducing ambient radiation. Over time, the official evacuation zones have been redefined and gradually reduced in area. This strategy diverges significantly from the responses to the Chernobyl and Three Mile Island accidents, where land abandonment and permanent relocation were more commonly pursued.

In Chernobyl, residents had the legal right to relocate even in areas exceeding 5 mSv annually—the threshold for controlled zones such as X-ray rooms in hospital. In contrast, most Fukushima evacuees outside the 20 km radius were classified as “voluntary,” receiving limited or no compensation. While the air dose in many of these areas fell between 5–20 mSv annually, they were not eligible for the same rights or government support as those in the official evacuation zones¹⁾.

The Japanese policy of emphasizing decontamination over long-term evacuation has been interpreted in two ways: as a response to the desires of communities seeking to return (Suzuki, 2013), and as a cost-control strategy by central government and utility companies (Fujimoto, 2015). In the short term, there appears to be a trade-off between decontamination and direct compensation; in the medium to long term, decontamination may also serve to minimize the financial liabilities of power companies and government actors.

1.2 Areas Subject to Evacuation

The areas subject to mandatory evacuation in the Fukushima disaster were generally limited to within a 20 km radius of the plant. While this is broader than what had been previously assumed in Japanese planning, it is narrower than the evacuation zones established following the Chernobyl accidents.

1) Mainly in the Nakadori region of Fukushima Prefecture, compensation of 200,000 yen has been paid once to each person, but this is temporary compensation. Accessed June 21, 2025, at <https://www.tepco.co.jp/en/hd/index-e.html>.

The government's definition of evacuation zones has been revised following the realization that the Fukushima accident—and its associated compensation burden—was beyond prior expectations of local and national authorities. According to the 2024 revision of the Guidelines for Nuclear Emergency Preparedness by the Nuclear Regulation Authority, evacuation planning is now divided into two zones: the Precautionary Action Zone (PAZ), within 5 km of the plant, and the Urgent Protective Action Planning Zone (UPZ), within 30 km.

However, these guidelines do not consider radiological impacts beyond 30 km. In the Fukushima case, air dose levels exceeding 5 mSv annually were observed up to 120 km from the site. Despite this, such areas were not officially designated for mandatory evacuation but were instead categorized as voluntary evacuation zones. Residents in these areas were eligible only for limited support, such as temporary rent subsidies (until March 2017), but were excluded from full compensation, including psychological damages and livelihood restoration (Fukushima prefecture, 2013).

By contrast, Ukraine and Belarus granted the right to evacuate to residents living beyond 30 km if air dose thresholds were surpassed. Following the Fukushima accident, the U.S. Embassy in Tokyo even recommended that its citizens evacuate from within 80 km of the plant.

In Japan, however, regional disaster prevention plans prepared by municipalities typically do not include provisions for mandatory evacuation beyond the 30 km range. Consequently, population surveys and evacuation planning beyond this threshold remain underdeveloped. Given the lessons from Fukushima, there is an urgent need to reassess the scope of emergency preparedness, particularly regarding demographic exposure beyond the standard UPZ.

2. Previous Studies and Research Methods for Estimating Populations Around Nuclear Power Plants

2.1 Review of Prior Research and Methodology

In the United States, Kohler, Kenneke, and Grimes (1975) conducted pioneering work estimating population distributions within specific radial distances from nuclear power plants. In Japan, Tani (2011) applied a similar methodology to 18 domestic nuclear power plant sites, calculating population totals within concentric zones—each 10 km in width—extending up to a 50 km radius, using data from the 2005 national census.

This study extends Tani's approach by broadening both the temporal and spatial scope. Specifically, it analyzes populations within a 100 km radius of nuclear facilities—both existing and planned—as of February 2025. Population data are derived from the 2000, 2010, and 2020 national censuses, aggregated by 500-meter mesh units to ensure high spatial resolution. The use of three census years allows for temporal comparisons that span the pre- and post-Fukushima accident periods.

Geospatial calculations were performed using ArcGIS Pro. Nuclear plant coordinates were obtained from the Japan National Geospatial Information Authority's JPGIS-compliant datasets. In the case of multi-reactor facilities, the coordinates of the earliest commissioned reactor were used to define the plant's location²⁾. Additionally, the Kaminoseki Nuclear Power Plant in Yamaguchi Prefecture—although not yet operational—is included, as it appears in

Table 1 List of regions where nuclear power plants are located (2025)

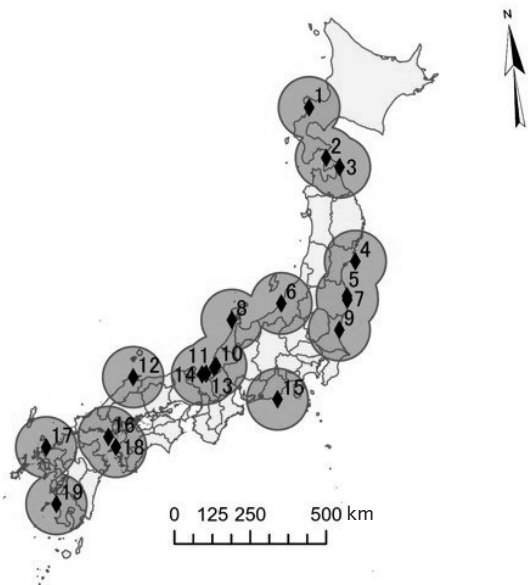
No.	Nuclear power plant name	Location prefecture name	Municipalities of location (1975)	Municipalities of location (2020)	Operating corporation	Latitude and longitude	
						Latitude	Longitude
1	Tomari	Hokkaido	Tomari Village	Tomari Village	Hokkaido Electric Power Co. inc.	43.0371	140.5141
2	Ōma	Aomori Prefecture	Ōma Town	Ōma Town	Power Development Co. inc.	41.5118	140.9204
3	Higashidōri	Aomori Prefecture	Higashidōri Village	Higashidōri Village	Tohoku Electric Power Co. inc.	41.1871	141.3873
4	Onagawa	Miyagi Prefecture	Onagawa Town	Onagawa Town	Tohoku Electric Power Co. inc.	38.3999	141.5012
5	Fukushima Daiichi	Fukushima Prefecture	Ōkuma Town and Futaba Town	Ōkuma Town and Futaba Town	Tokyo Electric Power Company. inc.	37.4231	141.0335
6	Kashiwazaki-Kariwa	Niigata Prefecture	Kashiwazaki City and Kariwa Village	Kashiwazaki City and Kariwa Village	Tokyo Electric Power Company. inc.	37.4217	138.5968
7	Fukushima Daini	Fukushima Prefecture	Naraha Town and Tomioka Town	Naraha Town and Tomioka Town	Tokyo Electric Power Company. inc.	37.3167	141.0263
8	Shika	Ishikawa Prefecture	Shika Town	Shika Town	Hokuriku Electric Power Company. inc.	37.0613	136.7272
9	Tokai	Ibaraki Prefecture	Tokai Village	Tokai Village	Japan Atomic Power Company	36.4666	140.6073
10	Tsuruga	Fukui Prefecture	Tsuruga City	Tsuruga City	Japan Atomic Power Company	35.7513	136.0310
11	Mihama	Fukui Prefecture	Mihama Town	Mihama Town	Kansai Electric Power Co. inc.	35.7025	135.9645
12	Shimane	Shimane Prefecture	Kashima Town	Matsue City	Chugoku Electric Power Co. inc.	35.5396	133.0080
13	Ōi	Fukui Prefecture	Ōi Town	Ōi Town	Kansai Electric Power Co. inc.	35.5388	135.6547
14	Takahama	Fukui Prefecture	Takahama Town	Takahama Town	Kansai Electric Power Co. inc.	35.5223	135.5085
15	Hamaoka	Shizuoka Prefecture	Hamaoka Town	Omaezaki City	Chubu Electric Power Co. inc.	34.6278	138.1454
16	Kaminoseki	Yamaguchi Prefecture	Kaminoseki Town	Kaminoseki Town	Chugoku Electric Power Co. inc.	33.7938	132.0578
17	Genkai	Saga Prefecture	Genkai Town	Genkai Town	Kyushu Electric Power Co. inc.	33.5132	129.8418
18	Ikata	Ehime Prefecture	Ikata Town	Ikata Town	Shikoku Electric Power Co. inc.	33.4914	132.3116
19	Sendai	Kagoshima Prefecture	Sendai City	Satsuma-Sendai City	Kyushu Electric Power Co. inc.	31.8294	130.1921

Source : Compiled based on "Power Plant Data," National Land Numerical Information Download Site (accessed January 10, 2025 : <https://www.stat.go.jp/ksj/jpgis/datalist/KsjTmpl-p03.html>).

Note 1 : Listed in order of latitude from north to south.

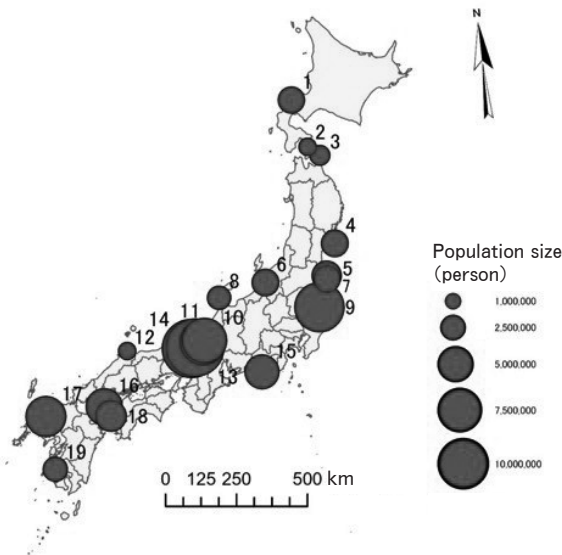
Note 2 : In cases where there are multiple nuclear reactors, the location of the oldest reactor in terms of the month and year of operation is used to obtain latitude and longitude information for the nuclear power plant site.

Figure 1 Map of nuclear power plant location points and their 100 km radius



Source: Same as Table 1.
Note: The numbers shown on the map correspond to the names of nuclear power plants in Table 1.

Figure 2 Population within 100 km of nuclear power plants (2020)



Source: Same as Table 1.

2) At January 2024, Japan had 60 nuclear reactors, 12 of which were in operation.
<https://www.enecho.meti.go.jp/about/pamphlet/energy2023/>

the national geospatial data as of February 2025. The full list of analyzed sites is presented in Table 1, Figure 1 and 2.

This methodology provides a consistent and replicable framework for evaluating spatial exposure across nuclear siting regions and allows comparison across multiple decades of demographic change (Table 1, Figure 1 and 2).

2.2 Nuclear Accidents, Distance, Exposure, and Disaster Planning

The Fukushima Daiichi nuclear disaster has prompted sustained criticism of Japan's reliance on distance-based criteria for determining evacuation zones and compensation eligibility. In practice, radioactive fallout does not disperse evenly in concentric circles around the plant. Instead, the actual contamination zones—defined by soil deposition and ambient air dose rates—are strongly influenced by meteorological and geographical factors such as wind direction, precipitation, topography, and atmospheric stability.

The release of radioactive materials following the hydrogen explosions in 2011 continued over time and spread unevenly. As a result, zones with elevated radiation doses emerged far beyond the initially assumed planning areas. Nonetheless, official disaster planning documents continued to rely heavily on distance-based delineations.

For example, the standard emergency planning zones typically extend to 5 km (PAZ: Precautionary Action Zone) and 30 km (UPZ: Urgent Protective Action Planning Zone), irrespective of actual contamination patterns.

This inconsistency between contamination reality and evacuation policy underscores the need for more refined planning models. Although distance remains a convenient proxy, it does not account for complex dispersion dynamics. Nonetheless, because disaster prevention plans in Japan are legally and administratively grounded in distance-based zoning, this study adopts a similar concentric-zone model to enable direct comparison with current policy frameworks. In doing so, it calculates the population within fixed radial distances from plant sites to assess the practical adequacy of such planning assumptions.

3. Population in Municipalities and Surrounding Areas of Nuclear Power Plants

3.1 Population Trends in Municipalities Hosting Nuclear Power Plants

Table 2 illustrates population trends in municipalities where nuclear power plants are located, spanning from 1980 to 2020. These plants are predominantly situated in small rural municipalities, where local finances are often heavily dependent on government subsidies and corporate contributions related to nuclear facility siting³⁾.

In 1980, all such municipalities had populations under 100,000. The smallest was Tomari Village, with only 2,788 residents, while the largest was Kashiwazaki-Kariwa, with 88,845. By 2020, several municipalities—Shimane (Matsue City), Sendai, Kashiwazaki-Kariwa, Ikata, Hamaoka, and Ōi—had undergone administrative mergers. Including merged areas, Matsue

3) At January 2007, Japan's total population had begun to decline, and the period from 1980 to 2020 included its peak population years. <https://www.stat.go.jp/english/data/kokusei/2020/summary.html>

Table 2 Population of Municipalities with Nuclear Power Plants

No.	Nuclear power plant name	Population in 1980 (excluding mergers)	Population in 1980 (including mergers)	Population in 2020 (excluding mergers)	Nominal population in 2020 (including mergers)	Municipal mergers (1975~2020)	Population growth rate (1980~2020)	Population Change (1980~2020) Including mergers	Population within 100 km of nuclear power plant (2020)
1	Tomari	2,788	—	1,569	—	None	-43.7%	—	2,957,550
2	Ōma	7,624	—	4,718	—	None	-38.1%	—	1,081,887
3	Higashidori	9,975	—	5,955	—	None	-40.3%	—	1,431,062
4	Onagawa	16,105	—	6,430	—	None	-60.1%	—	2,866,093
5	Fukushima Daiichi	17,313	—	847	—	None	-95.1%	—	3,431,372
6	Kashiwazaki-Kariwa	88,845	101,238	79,804	85,906	Merger	-10.2%	-15.1%	2,692,743
7	Fukushima Daini	23,307	—	5,838	—	None	-75.0%	—	2,489,797
8	Shika	30,636	—	18,630	—	None	-39.2%	—	2,196,471
9	Tokai	29,197	—	37,891	—	None	29.8%	—	9,951,024
10	Tsuruga	61,844	—	64,264	—	None	3.9%	—	8,130,011
11	Mihama	13,036	—	9,179	—	None	-29.6%	—	8,518,265
12	Shimane	9,094	194,173	6,282	203,616	Merger	-30.9%	4.9%	1,131,670
13	Ōi	6,177	9,156	5,745	7,910	Merger	-7.0%	-13.6%	14,042,858
14	Takahama	11,818	—	10,326	—	None	-12.6%	—	14,479,701
15	Hamaoka	19,859	33,479	21,077	31,103	Merger	6.1%	-7.1%	4,779,549
16	Kaminoseki	6,773	—	2,342	—	None	-65.4%	—	5,241,942
17	Genkai	7,463	—	5,609	—	None	-24.8%	—	6,615,009
18	Ikata	8,502	18,753	4,075	8,397	Merger	-52.1%	-55.2%	3,626,968
19	Sendai	65,645	102,143	70,741	89,654	Merger	-21.1%	-12.2%	2,159,972

Source: Compiled based on census data from 1980 and 2020.

Note (1): When municipal mergers took place between 1980 and 2020, the 1980 population (including merged municipalities) includes the figures for municipalities that were assumed to have merged in 1980.

Note (2): When municipal mergers took place between 1980 and 2020, the “2020 population (not including mergers)” includes the population living in the municipality in which the municipality was located in the 1980s as of 2020.

Note (3): In the case of nuclear power plants located in multiple municipalities, the population of each municipality is added up.

City, which hosts the Shimane plant, had the highest population at 204,000, representing a 4.9% growth.

However, when focusing exclusively on the pre-merger municipalities, notable population declines are observed. Kashima Town, the original host of the Shimane plant, experienced a significant decrease of -30.9%. Only three municipalities recorded population growth over the 40-year period: Tokai (+29.8%), Hamaoka (+6.1%), and Tsuruga (+3.9%). These trends reflect broader patterns of rural depopulation (Table 2).

3.2 Radial Population Analysis Centered on Nuclear Power Plants

This section examines population figures within fixed radial distances from each nuclear power plant site. The analysis adopts concentric zones corresponding to nuclear safety guidelines and historical precedents:

- 1 PAZ (Precautionary Action Zone) (5 km radius)
- 2 Conventional Disaster Prevention Measures Zone (10 km radius)
- 3 Official evacuation zone during the 2011 Fukushima disaster (20 km radius)
- 4 UPZ (Urgent Protective Action Planning Zone) (30 km radius)
- 5 Tani's study reference (50 km radius)
- 6 U.S. Embassy advisory zone post-Fukushima (80 km radius)
- 7 CEZ (Chernobyl Exclusion Zone standard) (100 km radius)

The 2020 census reveals that all nuclear plant sites had fewer than 50,000 residents within the 5 km PAZ. Only Tokai (48,000), Hamaoka (22,000), and Kashiwazaki-Kariwa (13,000) exceeded 10,000 inhabitants in this zone. Fukushima Daiichi had no registered residents, while six sites—including Tsuruga—had fewer than 1,000⁴⁾.

Within the 10 km radius (conventional zone), Tokai stood out with 222,000 residents, followed by Shimane (78,000), Kashiwazaki-Kariwa (73,000), and Hamaoka (60,000). In contrast, sites like Kaminoseki had just 2,208, underscoring significant disparities in population exposure risk.

In the 20 km zone—the evacuation radius employed during the Fukushima accident—2020 data show that Tokai has the highest number at 681,000 followed by Shimane (229,000), Hamaoka (188,000), and Kashiwazaki-Kariwa (157,000). However, Fukushima Daiichi and Daini were exceptional due to mandatory evacuations: Fukushima Daiichi lost approximately 24,000 residents, while Fukushima Daini lost nearly 14,000 between 2010 and 2020. Using 2010 data for comparison (pre-accident), Fukushima Daiichi had 76,000 residents, ranking 8th lowest among all sites, and Fukushima Daini had 65,000.

Only six sites had smaller 20 km populations than Fukushima Daiichi in 2010—Ikata, Ōi, Kaminoseki, Higashidōri, Tomari, and Ōma—suggesting that in a comparable nuclear accident, most other sites would face far greater evacuation burdens than Fukushima. Compen-

4) In this paper, population figures below 1,000 are omitted. When the total population is less than 1,000, the actual figure is shown.

Table 3 Population in the area from nuclear power plants (2020)

Rank	PAZ (5 km radius)		Conventional Disaster Prevention Measures Zone (10 km radius)		2011 Evacuation order (20 km radius)		UPZ-2011 Indoor evacuation (30 km radius)		Map created by Tani (50 km radius)		U.S. Embassy advice (80 km radius)		CEZ Chernobyl standard (100 km radius)	
	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)
1	Tokai (Ibaraki)	48,784	Tokai (Ibaraki)	222,600	Tokai (Ibaraki)	681,352	Tokai (Ibaraki)	889,325	Hamaoka (Shizuoka)	2,095,652	Takahama (Fukui)	5,897,956	Takahama (Fukui)	14,479,701
2	Hamaoka (Shizuoka)	22,937	Shimane (Shimane)	78,538	Shimane (Shimane)	229,527	Hamaoka (Shizuoka)	720,954	Genkai (Saga)	1,433,843	Ōi (Fukui)	5,380,385	Ōi (Fukui)	14,042,858
3	Kashiwazaki Kariwa (Niigata)	13,887	Kashiwazaki Kariwa (Niigata)	73,802	Hamaoka (Shizuoka)	188,954	Shimane (Shimane)	424,952	Tokai (Ibaraki)	1,366,861	Genkai (Saga)	5,063,914	Tokai (Ibaraki)	9,951,024
4	Shimane (Shimane)	7,490	Hamaoka (Shizuoka)	60,445	Kashiwazaki Kariwa (Niigata)	157,701	Kashiwazaki Kariwa (Niigata)	396,855	Sendai (Kagoshima)	1,019,470	Tokai (Ibaraki)	4,582,110	Mihama (Fukui)	8,518,265
5	Genkai (Saga)	5,788	Takahama (Fukui)	21,460	Genkai (Saga)	108,861	Tsuruga (Fukui)	256,810	Kashiwazaki Kariwa (Niigata)	1,003,960	Kaminoseki (Yamaguchi)	3,641,942	Tsuruga (Fukui)	8,130,011
6	Ōma (Aomori)	4,663	Genkai (Saga)	20,763	Sendai (Kagoshima)	108,573	Genkai (Saga)	231,530	Tsuruga (Fukui)	813,185	Mihama (Fukui)	3,551,281	Genkai (Saga)	6,615,009
7	Ikata (Ehime)	3,986	Sendai (Kagoshima)	20,143	Onagawa (Miyagi)	101,555	Sendai (Kagoshima)	195,323	Mihama (Fukui)	713,852	Hamaoka (Shizuoka)	3,380,074	Kaminoseki (Yamaguchi)	5,241,942
8	Takahama (Fukui)	3,911	Ōi (Fukui)	19,750	Tsuruga (Fukui)	96,263	Onagawa (Miyagi)	184,120	Shimane (Shimane)	678,944	Tsuruga (Fukui)	2,803,827	Hamaoka (Shizuoka)	4,779,549
9	Fukushima Daiichi (Fukushima)	3,744	Tomari (Hokkaido)	17,402	Takahama (Fukui)	84,160	Mihama (Fukui)	179,239	Onagawa (Miyagi)	625,689	Onagawa (Miyagi)	2,418,525	Ikata (Ehime)	3,626,968
10	Tomari (Hokkaido)	2,558	Shika (Ishikawa)	14,841	Mihama (Fukui)	79,833	Kaminoseki (Yamaguchi)	161,251	Shika (Ishikawa)	589,115	Tomari (Hokkaido)	2,307,985	Fukushima Daiichi (Fukushima)	3,431,372
11	Shika (Ishikawa)	2,173	Ikata (Ehime)	14,049	Shika (Ishikawa)	73,938	Tsuruga (Fukui)	154,551	Kaminoseki (Yamaguchi)	518,390	Ikata (Ehime)	2,098,789	Tomari (Hokkaido)	2,957,550
12	Sendai (Kagoshima)	2,020	Mihama (Fukui)	11,206	Fukushima Daiichi (Fukushima)	52,339	Shika (Ishikawa)	136,958	Fukushima Daiichi (Fukushima)	462,515	Shika (Ishikawa)	2,068,389	Onagawa (Miyagi)	2,866,093
13	Higashidori (Aomori)	1,645	Onagawa (Miyagi)	7,913	Fukushima Daiichi (Fukushima)	51,501	Ōi (Fukui)	122,725	Tsuruga (Fukui)	423,008	Kashiwazaki Kariwa (Niigata)	2,065,085	Kashiwazaki Kariwa (Niigata)	2,692,743
14	Onagawa (Miyagi)	847	Fukushima Daiichi (Fukushima)	7,428	Ikata (Ehime)	44,303	Ikata (Ehime)	107,392	Ōma (Aomori)	395,610	Fukushima Daiichi (Fukushima)	1,803,361	Fukushima Daiichi (Fukushima)	2,489,797
15	Ōi (Fukui)	688	Ōma (Aomori)	6,296	Ōi (Fukui)	35,944	Fukushima Daiichi (Fukushima)	75,221	Ōi (Fukui)	392,098	Fukushima Daiichi (Fukushima)	1,717,746	Shika (Ishikawa)	2,196,471
16	Kaminoseki (Yamaguchi)	553	Higashidori (Aomori)	4,038	Kaminoseki (Yamaguchi)	20,522	Fukushima Daiichi (Fukushima)	69,336	Fukushima Daiichi (Fukushima)	387,966	Sendai (Kagoshima)	1,544,392	Sendai (Kagoshima)	2,159,972
17	Mihama (Fukui)	485	Fukushima Daiichi (Fukushima)	3,846	Higashidori (Aomori)	18,671	Tomari (Hokkaido)	67,091	Ikata (Ehime)	578,518	Shimane (Shimane)	905,320	Higashidori (Aomori)	1,431,062
18	Tsuruga (Fukui)	255	Tsuruga (Fukui)	2,502	Tomari (Hokkaido)	13,345	Higashidori (Aomori)	62,983	Tomari (Hokkaido)	187,773	Higashidori (Aomori)	777,147	Shimane (Shimane)	1,131,670
19	Fukushima Daiichi (Fukushima)	0	Kaminoseki (Yamaguchi)	2,208	Ōma (Aomori)	8,088	Ōma (Aomori)	23,769	Higashidori (Aomori)	108,358	Ōma (Aomori)	700,546	Ōma (Aomori)	1,081,887

Source : Same as Table 1 and 2.

Table 4 Population in the area from nuclear power plants (2010)

Rank	PAZ (5 km radius)		Conventional Disaster Prevention Measures Zone (10 km radius)		2011 Evacuation order (20 km radius)		UPZ-2011 Indoor evacuation (30 km radius)		Map created by Tani (50 km radius)		U.S. Embassy advice (80 km radius)		CEZ Chernobyl standard (100 km radius)	
	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)	Nuclear power plant nam	Population (persons)
1	Tokai (Ibaraki)	51,112	Tokai (Ibaraki)	225,794	Tokai (Ibaraki)	709,471	Hamaoka (Shizuoka)	929,433	Hamaoka (Shizuoka)	2,124,787	Takahama (Fukui)	6,003,188	Takahama (Fukui)	14,568,480
2	Hamaoka (Shizuoka)	25,462	Shimane (Shimane)	81,388	Shimane (Shimane)	237,299	Hamaoka (Shizuoka)	733,072	Tokai (Ibaraki)	1,465,384	Ōi (Fukui)	5,502,119	Ōi (Fukui)	14,113,491
3	Kashiwazaki Kariwa (Niigata)	15,647	Kashiwazaki Kariwa (Niigata)	80,149	Hamaoka (Shizuoka)	201,279	Shimane (Shimane)	438,920	Genkai (Saga)	1,463,514	Genkai (Saga)	4,981,774	Tokai (Ibaraki)	10,318,230
4	Fukushima Daiichi (Fukushima)	13,251	Hamaoka (Shizuoka)	68,333	Kashiwazaki Kariwa (Niigata)	171,816	Kashiwazaki Kariwa (Niigata)	426,268	Kashiwazaki Kariwa (Niigata)	1,100,439	Tokai (Ibaraki)	4,900,445	Mihama (Fukui)	8,701,585
5	Fukushima Daini (Fukushima)	12,857	Fukushima Daiichi (Fukushima)	46,427	Genkai (Saga)	118,351	Tsuruga (Fukui)	271,990	Sendai (Kagoshima)	1,072,191	Kaminoseki (Yamaguchi)	3,775,261	Tsuruga (Fukui)	8,284,702
6	Shimane (Shimane)	9,403	Fukushima Daini (Fukushima)	30,129	Sendai (Kagoshima)	116,328	Genkai (Saga)	254,024	Tsuruga (Fukui)	858,033	Mihama (Fukui)	3,657,896	Genkai (Saga)	6,680,043
7	Genkai (Saga)	7,003	Genkai (Saga)	25,846	Onagawa (Miyagi)	112,653	Sendai (Kagoshima)	213,749	Mihama (Fukui)	758,537	Hamaoka (Shizuoka)	3,475,204	Kaminoseki (Yamaguchi)	5,459,546
8	Ōma (Aomori)	6,311	Takahama (Fukui)	23,624	Tsuruga (Fukui)	109,546	Onagawa (Miyagi)	211,543	Shimane (Shimane)	703,491	Tsuruga (Fukui)	2,920,749	Hamaoka (Shizuoka)	4,926,739
9	Ikata (Ehime)	4,911	Sendai (Kagoshima)	22,648	Takahama (Fukui)	105,604	Mihama (Fukui)	196,911	Onagawa (Miyagi)	689,182	Onagawa (Miyagi)	2,483,487	Ikata (Ehime)	3,867,398
10	Takahama (Fukui)	4,445	Ōi (Fukui)	21,443	Mihama (Fukui)	85,911	Kaminoseki (Yamaguchi)	178,445	Shika (Ishikawa)	640,745	Tonari (Hokkaido)	2,292,065	Fukushima Daiichi (Fukushima)	3,614,228
11	Tonari (Hokkaido)	2,942	Overnight (Hokkaido)	20,979	Shika (Ishikawa)	85,279	Takahama (Fukui)	172,764	Kaminoseki (Yamaguchi)	571,765	Ikata (Ehime)	2,243,828	Tonari (Hokkaido)	2,983,098
12	Shika (Ishikawa)	2,621	Shika (Ishikawa)	17,286	Fukushima Daiichi (Fukushima)	76,698	Shika (Ishikawa)	160,060	Fukushima Daini (Fukushima)	558,339	Kashiwazaki Kariwa (Niigata)	2,234,913	Onagawa (Miyagi)	2,970,817
13	Sendai (Kagoshima)	2,506	Ikata (Ehime)	16,579	Fukushima Daini (Fukushima)	65,464	Fukushima Daini (Fukushima)	144,790	Fukushima Daiichi (Fukushima)	482,671	Shika (Ishikawa)	2,151,789	Kashiwazaki Kariwa (Niigata)	2,931,439
14	Higashidori (Aomori)	2,226	Onagawa (Miyagi)	13,343	Ikata (Ehime)	62,907	Fukushima Daiichi (Fukushima)	138,638	Takahama (Fukui)	471,211	Fukushima Daini (Fukushima)	1,988,508	Fukushima Daini (Fukushima)	2,734,086
15	Onagawa (Miyagi)	1,804	Mihama (Fukui)	12,411	Ōi (Fukui)	56,888	Ōi (Fukui)	135,839	Ōma (Aomori)	440,873	Fukushima Daini (Fukushima)	1,900,469	Shika (Ishikawa)	2,344,188
16	Kaminoseki (Yamaguchi)	879	Ōma (Aomori)	8,724	Kaminoseki (Yamaguchi)	50,274	Ikata (Ehime)	126,388	Ōi (Fukui)	437,428	Sendai (Kagoshima)	1,670,902	Sendai (Kagoshima)	2,297,810
17	Ōi (Fukui)	760	Higashidori (Aomori)	5,331	Higashidori (Aomori)	39,748	Tonari (Hokkaido)	76,983	Ikata (Ehime)	327,652	Shimane (Shimane)	963,643	Higashidori (Aomori)	1,584,952
18	Mihama (Fukui)	636	Tsuruga (Fukui)	3,231	Tonari (Hokkaido)	24,740	Higashidori (Aomori)	69,323	Overights (Hokkaido)	220,414	Higashidori (Aomori)	849,256	Shimane (Shimane)	1,227,830
19	Tsuruga (Fukui)	373	Kaminoseki (Yamaguchi)	3,185	Ōma (Aomori)	11,132	Ōma (Aomori)	31,337	Higashidori (Aomori)	124,429	Ōma (Aomori)	793,217	Ōma (Aomori)	1,222,692

Source : Same as Table 1 and 2.

Table 5 Population in the area from nuclear power plants (2000)

Rank	PAZ (5 km radius)		Conventional Disaster Prevention Measures Zone (10 km radius)		2011 Evacuation order (20 km radius)		UPZ-2011 Indoor evacuation (30 km radius)		Map created by Tani (50 km radius)		U.S. Embassy advice (80 km radius)		CEZ Chernobyl standard (100 km radius)	
	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)
1	Tokai (Ibaraki)	49,213	Tokai (Ibaraki)	221,941	Tokai (Ibaraki)	716,994	Tokai (Ibaraki)	941,628	Hamaoka (Shizuoka)	2,097,788	Takahama (Fukui)	5,957,087	Takahama (Fukui)	14,395,286
2	Hamaoka (Shizuoka)	25,776	Kashiwazaki Kariwa (Niigata)	83,255	Shimane (Shimane)	241,804	Hamaoka (Shizuoka)	720,288	Tokai (Ibaraki)	1,513,419	Ōi (Fukui)	5,490,709	Ōi (Fukui)	13,912,216
3	Kashiwazaki Kariwa (Niigata)	15,932	Shimane (Shimane)	82,099	Hamaoka (Shizuoka)	204,133	Shimane (Shimane)	447,964	Genkai (Saga)	1,473,730	Tokai (Ibaraki)	4,925,879	Tokai (Ibaraki)	10,195,001
4	Fukushima Daiichi (Fukushima)	13,686	Hamaoka (Shizuoka)	70,716	Kashiwazaki Kariwa (Niigata)	178,538	Kashiwazaki Kariwa (Niigata)	444,226	Kashiwazaki Kariwa (Niigata)	1,157,798	Genkai (Saga)	4,897,911	Mihama (Fukui)	8,628,341
5	Fukushima Daini (Fukushima)	13,151	Fukushima Daiichi (Fukushima)	47,534	Onagawa (Miyagi)	126,316	Tsuruga (Fukui)	277,781	Sendai (Kagoshima)	1,102,620	Kaminoseki (Yamaguchi)	3,828,510	Tsuruga (Fukui)	8,196,611
6	Shimane (Shimane)	10,129	Fukushima Daini (Fukushima)	30,437	Genkai (Saga)	126,304	Genkai (Saga)	270,434	Tsuruga (Fukui)	873,857	Mihama (Fukui)	3,651,949	Genkai (Saga)	6,705,478
7	Genkai (Saga)	7,644	Genkai (Saga)	29,890	Sendai (Kagoshima)	122,240	Sendai (Kagoshima)	227,928	Mihama (Fukui)	776,145	Hamaoka (Shizuoka)	3,467,864	Kaminoseki (Yamaguchi)	5,559,309
8	Ōma (Aomori)	6,463	Takahama (Fukui)	25,293	Takahama (Fukui)	113,061	Onagawa (Miyagi)	227,346	Onagawa (Miyagi)	726,321	Tsuruga (Fukui)	2,940,564	Hamaoka (Shizuoka)	4,909,574
9	Ikata (Ehime)	5,739	Sendai (Kagoshima)	24,543	Tsuruga (Fukui)	112,558	Mihama (Fukui)	206,513	Shimane (Shimane)	723,263	Onagawa (Miyagi)	2,513,348	Ikata (Ehime)	4,004,230
10	Takahama (Fukui)	4,756	Tomari (Hokkaido)	23,896	Shika (Ishikawa)	93,500	Kaminoseki (Yamaguchi)	189,418	Shika (Ishikawa)	676,038	Kashiwazaki Kariwa (Niigata)	2,327,680	Fukushima Daiichi (Fukushima)	3,689,587
11	Tomari (Hokkaido)	3,245	Ōi (Fukui)	23,384	Mihama (Fukui)	88,433	Takahama (Fukui)	188,331	Kaminoseki (Yamaguchi)	608,131	Ikata (Ehime)	2,315,073	Kashiwazaki Kariwa (Niigata)	3,080,995
12	Shika (Ishikawa)	3,197	Shika (Ishikawa)	19,500	Fukushima Daiichi (Fukushima)	80,616	Shika (Ishikawa)	178,214	Fukushima Daini (Fukushima)	594,739	Tomari (Hokkaido)	2,182,129	Tomari (Hokkaido)	2,947,344
13	Sendai (Kagoshima)	2,864	Ikata (Ehime)	18,916	Ikata (Ehime)	73,545	Fukushima Daini (Fukushima)	155,599	Shika (Ishikawa)	532,710	Shika (Ishikawa)	2,066,689	Fukushima Daini (Fukushima)	2,845,014
14	Higashidori (Aomori)	2,450	Onagawa (Miyagi)	15,927	Fukushima Daini (Fukushima)	68,792	Ōi (Fukui)	146,852	Takahama (Fukui)	475,406	Fukushima Daini (Fukushima)	1,978,619	Sendai (Kagoshima)	2,479,544
15	Onagawa (Miyagi)	2,332	Mihama (Fukui)	12,221	Ōi (Fukui)	61,702	Fukushima Daiichi (Fukushima)	146,355	Ōma (Aomori)	468,478	Sendai (Kagoshima)	1,760,245	Shika (Ishikawa)	2,341,762
16	Kaminoseki (Yamaguchi)	1,212	Ōma (Aomori)	9,308	Kaminoseki (Yamaguchi)	54,561	Ikata (Ehime)	143,148	Ōi (Fukui)	371,053	Shimane (Shimane)	1,014,706	Higashidori (Aomori)	1,699,207
17	Ōi (Fukui)	1,127	Higashidori (Aomori)	6,376	Higashidori (Aomori)	41,875	Tomari (Hokkaido)	85,244	Ikata (Ehime)	249,004	Shimane (Shimane)	905,743	Ōma (Aomori)	1,331,703
18	Mihama (Fukui)	729	Kaminoseki (Yamaguchi)	4,101	Tomari (Hokkaido)	28,296	Higashidori (Aomori)	73,562	Overights (Hokkaido)	137,827	Ōma (Aomori)	868,916	Shimane (Shimane)	1,312,401
19	Tsuruga (Fukui)	454	Tsuruga (Fukui)	3,828	Ōma (Aomori)	12,234	OHMA (Aomori)	36,093	Higashidori (Aomori)					

Source : Same as Table 1 and 2.

sation budgets based on the Fukushima precedent would be insufficient at more densely populated sites.

The 30 km UPZ zone highlights even more stark disparities. In 2020, Tokai had 889,000 residents in this zone, followed by Hamaoka (720,000) and Shimane (424,000). Pre-accident figures from 2010 show Fukushima Daiichi and Daini with 138,000 and 144,000, respectively—again, relatively low compared to other sites. These figures suggest that if an accident of similar scale occurred elsewhere, the financial and logistical demands for compensation and evacuation would be far greater.

The 50 km radius, used in prior studies such as Tani's, shows even broader risk exposure: Hamaoka had over 2 million residents, while Genkai, Sendai, and Kashiwazaki-Kariwa each exceeded 1 million. Fukushima Daiichi had just 278,000 in 2020, ranking near the bottom.

The 80 km zone, which the U.S. Embassy used for its evacuation advisory after the 2011 accident, reveals high-density exposure: Takahama (5.89 million), Ōi (5.38 million), Genkai (5.06 million) and Tokai (4.58 million) had populations exceeding 4 million. Even Fukushima Daiichi had 1.8 million residents in this zone in 2020—highlighting the scope of potential displacement under expanded precautionary standards.

Finally, the 100 km CEZ standard—based on the Chernobyl precedent—shows the maximum spatial reach of potential contamination. Tokai had nearly 10 million residents within 100 km, while Takahama and Ōi surpassed 14 million. Even the least populated site, Ōma, had over 1 million residents in this radius.

These findings underscore the need to move beyond fixed radii in nuclear disaster planning. Population density, regional mobility, and infrastructure readiness vary greatly, and compensation frameworks must reflect these realities. Existing disaster response budgets based on Fukushima would be insufficient in most other locations, particularly those near major metropolitan centers (Table 3, Table 4 and Table 5).

4. Population by Zone from the Nuclear Power Plant Location

4.1 Population within the 30 km Radius

Tables 6 through Table 8 illustrate the distribution of population within concentric distance zones extending up to 30 km from each nuclear power plant site. These zones reflect Japan's official emergency planning parameters, as well as international radiological safety standards.

In 2020, Tokai recorded the largest population within the 3 km radius, with 14,000 residents. It was followed by Hamaoka (9,592), Shimane (4,367), and Ōma (4,033). In stark contrast, Fukushima Daiichi had no residents within this zone due to enforced evacuation following the 2011 accident. However, in 2010—prior to the disaster—Fukushima Daiichi had approximately 2,780 residents in this area, placing it 8th among all nuclear power plant sites.

Within the 3–5 km range, only Tokai (34,000), Hamaoka (13,000), and Kashiwazaki-Kariwa (10,000) exceeded 10,000 inhabitants. Fukushima Daiichi again had zero residents in 2020 but had 10,000 in 2010, ranking fourth at that time.

In the 5–10 km zone, Tokai had the highest figure with 173,000, followed by Shimane (71,000). Fukushima Daiichi ranked sixth from the bottom with 3,846 in 2020, though in 2010 it recorded 33,000, ranking fifth.

The 10–20 km range showed the largest populations in Tokai (458,000), Shimane (150,000), and Hamaoka (128,000). The least populated areas included Ōma (1,792), Tomari (3,120), and Fukushima Daiichi (9,499). These figures suggest a slight rebound in population around Fukushima Daiichi, although still far below pre-accident levels.

In the 20–30 km band, Hamaoka (532,000), Kashiwazaki-Kariwa (239,000), and Tokai (207,000) each had over 200,000 residents. Meanwhile, Ōma (15,000), Higashidōri (27,000), and Tomari (46,000) had comparatively fewer residents. Fukushima Daiichi had 55,000 in this range in 2020, ranking fifth from the bottom. Its 2010 figure was slightly higher at 61,000, ranking fourth from the bottom.

These disparities in population concentration underscore the varying scales of risk and the potential difficulty of implementing uniform evacuation or compensation strategies across nuclear sites.

4.2 Population beyond the 30 km Radius

Although the area beyond the 30 km radius is not officially designated as a mandatory evacuation zone in Japan, it has received sustained attention due to radioactive contamination during the Fukushima accident. Reconstruction efforts in these areas have primarily focused on decontamination rather than relocation or compensation.

In the 30–40 km range, seven plant sites had populations exceeding 200,000 in 2020. Hamaoka topped the list with 569,000 residents, while Shimane also surpassed 200,000. The lowest number is in Higashidōri with 11,000 people. Fukushima Daiichi ranked third from the bottom in 2020 with 77,000 and third from the bottom in 2010 (91,000).

Within the 40–50 km zone, Genkai (840,000), Hamaoka (805,000), and Sendai (678,000) each recorded over half a million residents. Fukushima Daiichi had 241,000 in 2020 (ranked 10th), and 262,000 in 2010—again 10th.

In the 50–60 km band, Genkai (1.62 million), Onagawa (1.17 million), and Ōi (1.09 million) exceeded one million. Meanwhile, Ōma (22,000), Shimane (42,000), Tomari (75,000), and Higashidōri (82,000) had the lowest populations. Fukushima Daiichi had 534,000 residents (8th in 2020), slightly down from 556,000 in 2010.

In the 60–70 km range, six plant sites had populations exceeding 1 million, including Ōi (2.13 million), Takahama (1.74 million), Tokai (1.47 million), Genkai (1.15 million), Tomari (1.14 million), and Kaminoseki (1.01 million). In contrast, Ōma (32,000) and Shimane (52,000) were the only sites below 100,000. Fukushima Daiichi ranked 8th, with 616,000 residents in 2020, and 654,000 in 2010.

In the 70–80 km range, the most populous sites included Takahama (2.94 million), Kaminoseki (1.86 million), Mihama (1.82 million), Ōi (1.76 million), Tsuruga (1.19 million), and Tokai (1.12 million). Fukushima Daiichi ranked sixth from the bottom with 264,000, the same rank as in 2010 (284,000).

In the 80–90 km radius, Takahama (4.10 million), Ōi (3.68 million), Tsuruga (2.61 million), Mihama (2.43 million), and Tokai (1.69 million) had the largest populations. Fukushima Daiichi ranked seventh from the bottom in 2010 with 382,000.

Finally, in the 90–100 km band, Fukushima Daiichi had 1.24 million residents in 2020—

Table 6 Population by distance zone from nuclear power plants (2020)

Rank	3 km radius		3-5 km radius		5-10 km radius		10-20 km radius		20-30 km radius		30-40 km radius	
	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)
1	Tokai (Ibaraki)	14,716	Tokai (Ibaraki)	34,068	Tokai (Ibaraki)	173,816	Tokai (Ibaraki)	458,752	Hamaoka (Shizuoka)	532,000	Hamaoka (Shizuoka)	569,075
2	Hamaoka (Shizuoka)	9,592	Hamaoka (Shizuoka)	13,345	Shimane (Shimane)	71,048	Shimane (Shimane)	150,989	Kashiwazaki Kariwa (Niigata)	239,164	Genkai (Saga)	361,866
3	Shimane (Shimane)	4,367	Kashiwazaki Kariwa (Niigata)	10,166	Kashiwazaki Kariwa (Niigata)	59,905	Hamaoka (Shizuoka)	128,509	Tokai (Ibaraki)	207,973	Ōma (Aomori)	307,441
4	Ōma (Aomori)	4,033	Takahama (Fukui)	3,481	Hamaoka (Shizuoka)	37,508	Tsuruga (Fukui)	99,053	Shimane (Shimane)	195,425	Kashiwazaki Kariwa (Niigata)	262,441
5	Kashiwazaki Kariwa (Niigata)	3,731	Genkai (Saga)	3,229	Ōi (Fukui)	19,062	Sendai (Kagoshima)	88,718	Tsuruga (Fukui)	155,255	Tsuruga (Fukui)	239,783
6	Genkai (Saga)	2,559	Shimane (Shimane)	3,123	Sendai (Kagoshima)	18,123	Genkai (Saga)	87,810	Genkai (Saga)	122,957	Fukushima Daiichi (Fukushima)	228,431
7	Tomari (Hokkaido)	1,638	Ikata (Ehime)	2,452	Takahama (Fukui)	17,549	Kashiwazaki Kariwa (Niigata)	83,899	Kaminoseki (Yamaguchi)	116,948	Shimane (Shimane)	211,288
8	Ikata (Ehime)	1,534	Fukushima Daiichi (Fukushima)	2,220	Genkai (Saga)	14,975	Onagawa (Miyagi)	76,247	Onagawa (Miyagi)	99,960	Mihama (Fukui)	189,724
9	Fukushima Daiichi (Fukushima)	1,524	Higashidori (Aomori)	1,470	Tomari (Hokkaido)	14,844	Takahama (Fukui)	74,803	Mihama (Fukui)	99,406	Tokai (Ibaraki)	187,897
10	Shika (Ishikawa)	1,153	Sendai (Kagoshima)	1,327	Shika (Ishikawa)	12,668	Mihama (Fukui)	68,627	Sendai (Kagoshima)	86,462	Kaminoseki (Yamaguchi)	170,162
11	Sendai (Kagoshima)	693	Shika (Ishikawa)	1,020	Mihama (Fukui)	10,721	Shika (Ishikawa)	59,097	Ōi (Fukui)	70,386	Sendai (Kagoshima)	145,664
12	Onagawa (Miyagi)	585	Tomari (Hokkaido)	920	Ikata (Ehime)	10,063	Kaminoseki (Yamaguchi)	42,095	Shika (Ishikawa)	63,020	Ōi (Fukui)	126,788
13	Ōi (Fukui)	556	Ōma (Aomori)	630	Onagawa (Miyagi)	7,066	Ikata (Ehime)	37,452	Takahama (Fukui)	58,288	Takahama (Fukui)	104,551
14	Takahama (Fukui)	430	Kaminosekin (Yamaguchi)	464	Fukushima Daiichi (Fukushima)	3,846	Ōi (Fukui)	32,589	Fukushima Daoni (Fukushima)	56,550	Onagawa (Miyagi)	93,867
15	Miyama (Fukui)	423	Onagawa (Miyagi)	262	Fukushima Daiichi (Fukushima)	3,684	Higashidori (Aomori)	31,906	Fukushima Daiichi (Fukushima)	55,991	Shika (Ishikawa)	91,813
16	Higashidori (Aomori)	175	Tsuruga (Fukui)	149	Higashidori (Aomori)	2,393	Fukushima Daiichi (Fukushima)	11,243	Ikata (Ehime)	55,891	Ikata (Ehime)	81,477
17	Tsuruga (Fukui)	106	Ōi (Fukui)	132	Tsuruga (Fukui)	2,247	Fukushima Daiichi (Fukushima)	9,499	Tomari (Hokkaido)	46,569	Fukushima Daiichi (Fukushima)	77,562
18	Kaminoseki (Yamaguchi)	89	Mihama (Fukui)	62	Kaminoseki (Yamaguchi)	1,655	Tomari (Hokkaido)	3,120	Higashidori (Aomori)	27,039	Tomari (Hokkaido)	15,442
19	Fukushima Daiichi (Fukushima)	0	Fukushima Daiichi (Fukushima)	0	Ōma (Aomori)	1,633	Ōma (Aomori)	1,797	Ōma (Aomori)	15,681	Higashidori (Aomori)	11,503

Table 6 (continued)

Rank	40-50 km radius		50-60 km radius		60-70 km radius		70-80 km radius		80-90 km radius		90-100 km radius	
	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)
1	Genkai (Saga)	840,447	Genkai (Saga)	1,622,043	Ōi (Fukui)	2,134,078	Takahama (Fukui)	2,932,226	Takahama (Fukui)	4,104,144	Ōi (Fukui)	4,981,786
2	Hamaoka (Shizuoka)	805,623	Onagawa (Miyagi)	1,171,761	Takahama (Fukui)	1,736,021	Kaminoseki (Yamaguchi)	1,850,564	Ōi (Fukui)	3,680,687	Takahama (Fukui)	4,477,601
3	Sendai (Kagoshima)	678,483	Ōi (Fukui)	1,090,687	Tokai (Ibaraki)	1,471,224	Mihama (Fukui)	1,813,399	Tsuruga (Fukui)	2,612,697	Tokai (Ibaraki)	3,678,788
4	Shika (Ishikawa)	360,344	Takahama (Fukui)	800,701	Genkai (Saga)	1,150,248	Ōi (Fukui)	1,763,522	Mihama (Fukui)	2,433,358	Tsuruga (Fukui)	2,713,487
5	Onagawa (Miyagi)	347,702	Shika (Ishikawa)	724,319	Tomari (Hokkaido)	1,137,725	Tsuruga (Fukui)	1,186,981	Tokai (Ibaraki)	1,690,126	Mihama (Fukui)	2,533,626
6	Mihama (Fukui)	344,889	Tokai (Ibaraki)	622,028	Kaminoseki (Yamaguchi)	1,008,176	Tokai (Ibaraki)	1,121,997	Genkai (Saga)	919,288	Fukushima Daiichi (Fukushima)	1,240,071
7	Kashiwazaki Kariwa (Niigata)	344,654	Ikata (Ehime)	609,478	Mihama (Fukui)	633,125	Tomari (Hokkaido)	906,697	Kaminoseki (Yamaguchi)	860,073	Ikata (Ehime)	936,062
8	Tsuruga (Fukui)	316,592	Fukushima Daiichi (Fukushima)	534,324	Fukushima Daiichi (Fukushima)	616,799	Genkai (Saga)	857,780	Hamaoka (Shizuoka)	656,540	Hamaoka (Shizuoka)	742,935
9	Tokai (Ibaraki)	289,839	Fukushima Daini (Fukushima)	427,986	Shika (Ishikawa)	577,475	Ikata (Ehime)	721,529	Ikata (Ehime)	592,117	Kaminoseki (Yamaguchi)	739,927
10	Fukushima Daiichi (Fukushima)	241,068	Mihama (Fukui)	385,905	Tsuruga (Fukui)	549,669	Hamaoka (Shizuoka)	668,786	Sendai (Kagoshima)	449,255	Genkai (Saga)	631,807
11	Kaminoseki (Yamaguchi)	186,977	Hamaoka (Shizuoka)	317,342	Kashiwazaki Kariwa (Niigata)	539,189	Fukushima Daini (Fukushima)	381,844	Tomari (Hokkaido)	394,566	Fukushima Daini (Fukushima)	479,860
12	Takahama (Fukui)	163,906	Kaminoseki (Yamaguchi)	255,812	Ikata (Ehime)	489,264	Kashiwazaki Kariwa (Niigata)	298,502	Fukushima Daiichi (Fukushima)	387,940	Kashiwazaki Kariwa (Niigata)	388,150
13	Fukushima Daini (Fukushima)	158,863	Tsuruga (Fukui)	253,992	Fukushima Daini (Fukushima)	445,401	Higashidori (Aomori)	294,093	Higashidori (Aomori)	360,696	Higashidori (Aomori)	293,219
14	Ōi (Fukui)	142,585	Kashiwazaki Kariwa (Niigata)	223,434	Onagawa (Miyagi)	418,560	Fukushima Daiichi (Fukushima)	264,272	Fukushima Daini (Fukushima)	292,191	Onagawa (Miyagi)	267,735
15	Tomari (Hokkaido)	105,240	Sendai (Kagoshima)	169,355	Hamaoka (Shizuoka)	298,294	Ōma (Aomori)	249,788	Kashiwazaki Kariwa (Niigata)	239,508	Tomari (Hokkaido)	254,999
16	Ikata (Ehime)	89,649	Higashidori (Aomori)	82,423	Higashidori (Aomori)	292,273	Sendai (Kagoshima)	203,415	Onagawa (Miyagi)	179,833	Ōma (Aomori)	224,681
17	Ōma (Aomori)	64,400	Tomari (Hokkaido)	75,790	Sendai (Kagoshima)	152,152	Onagawa (Miyagi)	202,515	Ōma (Aomori)	156,660	Sendai (Kagoshima)	166,325
18	Shimane (Shimane)	42,704	Shimane (Shimane)	42,401	Shimane (Shimane)	52,593	Shika (Ishikawa)	177,480	Shimane (Shimane)	117,208	Shimane (Shimane)	109,142
19	Higashidori (Aomori)	33,872	Ōma (Aomori)	22,604	Ōma (Aomori)	32,544	Shimane (Shimane)	131,382	Shika (Ishikawa)	64,661	Shika (Ishikawa)	63,421

Source : Same as Table 1 and Figure 2.

Table 7 Population by distance zone from nuclear power plants (2010)

Rank	3 km radius		3-5 km radius		5-10 km radius		10-20 km radius		20-30 km radius		30-40 km radius	
	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)
1	Tokai (Ibaraki)	15,677	Tokai (Ibaraki)	35,435	Tokai (Ibaraki)	174,682	Tokai (Ibaraki)	483,677	Hamaoka (Shizuoka)	531,793	Hamaoka (Shizuoka)	577,833
2	Hamaoka (Shizuoka)	10,944	Hamaoka (Shizuoka)	14,508	Shimane (Shimane)	71,985	Shimane (Shimane)	155,911	Kashiwazaki Kariwa (Niigata)	254,452	Genkai (Saga)	371,357
3	Shimane (Shimane)	5,783	Kashiwazaki Kariwa (Niigata)	11,583	Kashiwazaki Kariwa (Niigata)	64,502	Hamaoka (Shizuoka)	132,946	Tokai (Ibaraki)	219,962	Ōma (Aomori)	338,142
4	Fukushima Daini (Fukushima)	5,485	Fukushima Daiichi (Fukushima)	10,471	Hamaoka (Shizuoka)	42,881	Tsuruga (Fukui)	106,315	Shimane (Shimane)	201,621	Kashiwazaki Kariwa (Niigata)	295,754
5	Ōma (Aomori)	5,404	Fukushima Daini (Fukushima)	7,372	Fukushima Daiichi (Fukushima)	33,176	Onagawa (Miyagi)	99,310	Tsuruga (Fukui)	162,444	Tsuruga (Fukui)	254,833
6	Kashiwazaki Kariwa (Niigata)	4,064	Genkai (Saga)	4,129	Ōi (Fukui)	20,683	Sendai (Kagoshima)	93,680	Genkai (Saga)	135,673	Fukushima Daini (Fukushima)	243,332
7	Genkai (Saga)	2,874	Takahama (Fukui)	3,864	Sendai (Kagoshima)	20,142	Genkai (Saga)	92,505	Kaminoseki (Yamaguchi)	128,171	Shimane (Shimane)	214,283
8	Fukushima Daiichi (Fukushima)	2,780	Shimane (Shimane)	3,620	Takahama (Fukui)	19,179	Kashiwazaki Kariwa (Niigata)	91,667	Mihama (Fukui)	111,000	Tokai (Ibaraki)	211,080
9	Ikata (Ehime)	2,022	Ikata (Ehime)	2,889	Genkai (Saga)	18,843	Takahama (Fukui)	81,980	Onagawa (Miyagi)	98,890	Mihama (Fukui)	200,494
10	Tomari (Hokkaido)	1,775	Higashidori (Aomori)	2,000	Tomari (Hokkaido)	18,037	Mihama (Fukui)	73,500	Sendai (Kagoshima)	97,421	Kaminoseki (Yamaguchi)	182,742
11	Shika (Ishikawa)	1,349	Sendai (Kagoshima)	1,657	Fukushima Daini (Fukushima)	17,272	Shika (Ishikawa)	67,993	Fukushima Daini (Fukushima)	79,326	Sendai (Kagoshima)	160,039
12	Onagawa (Miyagi)	1,037	Shika (Ishikawa)	1,272	Shika (Ishikawa)	14,665	Kaminoseki (Yamaguchi)	47,089	Ōi (Fukui)	78,951	Ōi (Fukui)	140,764
13	Sendai (Kagoshima)	849	Tomari (Hokkaido)	1,167	Mihama (Fukui)	11,775	Ikata (Ehime)	46,328	Shika (Ishikawa)	74,781	Takahama (Fukui)	118,423
14	Ōi (Fukui)	641	Ōma (Aomori)	907	Ikata (Ehime)	11,668	Ōi (Fukui)	35,445	Takahama (Fukui)	67,160	Onagawa (Miyagi)	111,429
15	Takahama (Fukui)	581	Onagawa (Miyagi)	767	Onagawa (Miyagi)	11,539	Fukushima Daini (Fukushima)	35,335	Ikata (Ehime)	63,481	Shika (Ishikawa)	101,228
16	Mihama (Fukui)	559	Kaminoseki (Yamaguchi)	734	Higashidori (Aomori)	3,105	Higashidori (Aomori)	34,417	Fukushima Daiichi (Fukushima)	61,940	Ikata (Ehime)	97,319
17	Higashidori (Aomori)	226	Tsuruga (Fukui)	177	Tsuruga (Fukui)	2,858	Fukushima Daiichi (Fukushima)	30,271	Tomari (Hokkaido)	52,243	Fukushima Daiichi (Fukushima)	91,626
18	Tsuruga (Fukui)	196	Ōi (Fukui)	119	Ōma (Aomori)	2,423	Tomari (Hokkaido)	3,761	Higashidori (Aomori)	29,575	Tomari (Hokkaido)	18,925
19	Kaminoseki (Yamaguchi)	145	Mihama (Fukui)	77	Kaminoseki (Yamaguchi)	2,306	Ōma (Aomori)	2,398	Ōma (Aomori)	20,205	Higashidori (Aomori)	14,496

Table 7 (continued)

Rank	40-50 km radius		50-60 km radius		60-70 km radius		70-80 km radius		80-90 km radius		90-100 km radius	
	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)
1	Genkai (Saga)	838,133	Genkai (Saga)	1,507,170	Ōi (Fukui)	2,119,889	Takahama (Fukui)	2,958,833	Takahama (Fukui)	4,102,777	Ōi (Fukui)	4,920,229
2	Hamaoka (Shizuoka)	813,882	Onagawa (Miyagi)	1,135,903	Takahama (Fukui)	1,740,610	Kaminoseki (Yamaguchi)	1,889,413	Ōi (Fukui)	3,691,143	Takahama (Fukui)	4,462,515
3	Sendai (Kagoshima)	698,403	Ōi (Fukui)	1,123,496	Tokai (Ibaraki)	1,521,732	Mihama (Fukui)	1,830,464	Tsuruga (Fukui)	2,633,919	Tokai (Ibaraki)	3,650,233
4	Shika (Ishikawa)	379,457	Takahama (Fukui)	832,534	Genkai (Saga)	1,114,546	Ōi (Fukui)	1,821,306	Mihama (Fukui)	2,477,309	Tsuruga (Fukui)	2,730,034
5	Kashiwazaki Kariwa (Niigata)	378,417	Shika (Ishikawa)	731,949	Tomari (Hokkaido)	1,101,306	Tokai (Ibaraki)	1,267,151	Tokai (Ibaraki)	1,767,552	Mihama (Fukui)	2,566,380
6	Onagawa (Miyagi)	366,210	Tokai (Ibaraki)	646,178	Kaminoseki (Yamaguchi)	1,031,447	Tsuruga (Fukui)	1,204,672	Genkai (Saga)	1,004,133	Fukushima Daiichi (Fukushima)	1,243,349
7	Mihama (Fukui)	361,132	Ikata (Ehime)	631,644	Mihama (Fukui)	665,846	Genkai (Saga)	896,544	Kaminoseki (Yamaguchi)	902,427	Ikata (Ehime)	971,744
8	Tsuruga (Fukui)	331,210	Fukushima Daiichi (Fukushima)	556,114	Fukushima Daiichi (Fukushima)	654,978	Tomari (Hokkaido)	890,547	Hamaoka (Shizuoka)	692,397	Kaminoseki (Yamaguchi)	781,860
9	Tokai (Ibaraki)	324,871	Fukushima Daini (Fukushima)	456,493	Shika (Ishikawa)	589,412	Ikata (Ehime)	764,552	Ikata (Ehime)	651,826	Hamaoka (Shizuoka)	759,138
10	Fukushima Daiichi (Fukushima)	262,407	Mihama (Fukui)	403,049	Tsuruga (Fukui)	583,691	Hamaoka (Shizuoka)	689,501	Sendai (Kagoshima)	476,955	Genkai (Saga)	694,136
11	Kaminoseki (Yamaguchi)	210,578	Hamaoka (Shizuoka)	343,430	Kashiwazaki Kariwa (Niigata)	562,320	Fukushima Daini (Fukushima)	409,805	Tomari (Hokkaido)	425,938	Fukushima Daini (Fukushima)	513,874
12	Takahama (Fukui)	180,024	Kaminoseki (Yamaguchi)	282,636	Ikata (Ehime)	519,980	Kashiwazaki Kariwa (Niigata)	328,784	Higashidori (Aomori)	409,151	Kashiwazaki Kariwa (Niigata)	429,074
13	Fukushima Daini (Fukushima)	170,217	Tsuruga (Fukui)	274,353	Fukushima Daini (Fukushima)	475,832	Higashidori (Aomori)	314,302	Fukushima Daiichi (Fukushima)	382,371	Higashidori (Aomori)	326,545
14	Ōi (Fukui)	160,825	Kashiwazaki Kariwa (Niigata)	243,370	Onagawa (Miyagi)	430,774	Fukushima Daiichi (Fukushima)	284,745	Fukushima Daini (Fukushima)	319,743	Onagawa (Miyagi)	287,654
15	Tomari (Hokkaido)	124,506	Sendai (Kagoshima)	183,966	Higashidori (Aomori)	321,608	Ōma (Aomori)	281,753	Kashiwazaki Kariwa (Niigata)	267,452	Tomari (Hokkaido)	265,095
16	Ikata (Ehime)	103,945	Higashidori (Aomori)	88,917	Hamaoka (Shizuoka)	317,486	Sendai (Kagoshima)	231,045	Onagawa (Miyagi)	199,676	Ōma (Aomori)	255,934
17	Ōma (Aomori)	71,394	Tomari (Hokkaido)	79,798	Sendai (Kagoshima)	183,700	Onagawa (Miyagi)	227,628	Ōma (Aomori)	173,541	Sendai (Kagoshima)	196,331
18	Shimane (Shimane)	50,288	Shimane (Shimane)	50,109	Shimane (Shimane)	61,751	Shika (Ishikawa)	189,683	Shimane (Shimane)	134,497	Shimane (Shimane)	129,690
19	Higashidori (Aomori)	40,610	Ōma (Aomori)	29,096	Ōma (Aomori)	41,495	Shimane (Shimane)	148,292	Shika (Ishikawa)	71,188	Shika (Ishikawa)	74,833

Source: Same as Table 1 and Figure 2.

Table 8 Population by distance zone from nuclear power plants (2000)

Rank	3 km radius		3-5 km radius		5-10 km radius		10-20 km radius		20-30 km radius		30-40 km radius	
	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)
1	Tokai (Ibaraki)	14,619	Tokai (Ibaraki)	34,594	Tokai (Ibaraki)	172,728	Tokai (Ibaraki)	495,053	Hamaoka (Shizuoka)	516,095	Hamaoka (Shizuoka)	573,910
2	Hamaoka (Shizuoka)	11,309	Hamaoka (Shizuoka)	14,467	Shimane (Shimane)	71,970	Shimane (Shimane)	159,705	Kashiwazaki Kariwa (Niigata)	265,688	Genkai (Saga)	380,101
3	Shimane (Shimane)	6,129	Kashiwazaki Kariwa (Niigata)	11,989	Kashiwazaki Kariwa (Niigata)	67,323	Hamaoka (Shizuoka)	133,477	Tokai (Ibaraki)	224,634	Ōma (Aomori)	362,897
4	Fukushima Daini (Fukushima)	5,855	Fukushima Daiichi (Fukushima)	10,673	Hamaoka (Shizuoka)	44,940	Onagawa (Miyagi)	110,389	Shimane (Shimane)	206,160	Kashiwazaki Kariwa (Niigata)	320,229
5	Ōma (Aomori)	5,354	Fukushima Daini (Fukushima)	7,296	Fukushima Daiichi (Fukushima)	33,848	Tsuruga (Fukui)	108,730	Tsuruga (Fukui)	165,223	Tsuruga (Fukui)	265,904
6	Kashiwazaki Kariwa (Niigata)	3,943	Genkai (Saga)	4,700	Ōi (Fukui)	22,257	Sendai (Kagoshima)	97,697	Genkai (Saga)	144,130	Fukushima Daini (Fukushima)	257,844
7	Fukushima Daiichi (Fukushima)	3,013	Shimane (Shimane)	4,000	Genkai (Saga)	22,246	Genkai (Saga)	96,414	Kaminoseki (Yamaguchi)	134,857	Tokai (Ibaraki)	225,522
8	Genkai (Saga)	2,944	Takahama (Fukui)	3,962	Sendai (Kagoshima)	21,679	Kashiwazaki Kariwa (Niigata)	95,283	Mihama (Fukui)	118,080	Shimane (Shimane)	217,941
9	Ikata (Ehime)	2,523	Ikata (Ehime)	3,216	Tomari (Hokkaido)	20,651	Takahama (Fukui)	87,768	Sendai (Kagoshima)	105,688	Mihama (Fukui)	204,465
10	Tomari (Hokkaido)	1,889	Sendai (Kagoshima)	1,802	Takahama (Fukui)	20,537	Mihama (Fukui)	76,212	Onagawa (Miyagi)	101,030	Kaminoseki (Yamaguchi)	189,932
11	Shika (Ishikawa)	1,569	Higashidori (Aomori)	1,783	Fukushima Daini (Fukushima)	17,286	Shika (Ishikawa)	74,000	Fukushima Daini (Fukushima)	86,807	Sendai (Kagoshima)	171,097
12	Onagawa (Miyagi)	1,234	Shika (Ishikawa)	1,628	Shika (Ishikawa)	16,303	Ikata (Ehime)	54,629	Ōi (Fukui)	85,150	Ōi (Fukui)	147,159
13	Sendai (Kagoshima)	1,062	Tomari (Hokkaido)	1,356	Onagawa (Miyagi)	13,595	Kaminoseki (Yamaguchi)	50,460	Shika (Ishikawa)	84,714	Takahama (Fukui)	128,233
14	Ōi (Fukui)	914	Ōma (Aomori)	1,109	Ikata (Ehime)	13,177	Fukushima Daini (Fukushima)	38,355	Takahama (Fukui)	75,270	Onagawa (Miyagi)	126,062
15	Takahama (Fukui)	794	Onagawa (Miyagi)	1,098	Mihama (Fukui)	11,492	Ōi (Fukui)	38,318	Ikata (Ehime)	69,603	Ikata (Ehime)	110,684
16	Higashidori (Aomori)	667	Kaminoseki (Yamaguchi)	1,034	Higashidori (Aomori)	3,926	Higashidori (Aomori)	35,499	Fukushima Daiichi (Fukushima)	65,739	Shika (Ishikawa)	108,163
17	Mihama (Fukui)	649	Ōi (Fukui)	213	Tsuruga (Fukui)	3,374	Fukushima Daiichi (Fukushima)	33,082	Tomari (Hokkaido)	56,948	Fukushima Daiichi (Fukushima)	102,704
18	Tsuruga (Fukui)	300	Tsuruga (Fukui)	154	Kaminoseki (Yamaguchi)	2,889	Tomari (Hokkaido)	4,400	Higashidori (Aomori)	31,687	Tomari (Hokkaido)	21,663
19	Kaminoseki (Yamaguchi)	178	Mihama (Fukui)	80	Ōma (Aomori)	2,845	Ōma (Aomori)	2,926	Ōma (Aomori)	23,859	Higashidori (Aomori)	17,592

Table 8 (continued)

Rank	40-50 km radius		50-60 km radius		60-70 km radius		70-80 km radius		80-90 km radius		90-100 km radius	
	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)	Nuclear power plant name	Population (persons)
1	Genkai (Saga)	823,195	Genkai (Saga)	1,414,084	Ōi (Fukui)	2,054,180	Takahama (Fukui)	2,888,136	Takahama (Fukui)	4,088,676	Ōi (Fukui)	4,757,909
2	Hamaoka (Shizuoka)	803,590	Ōi (Fukui)	1,133,128	Takahama (Fukui)	1,707,497	Kaminoseki (Yamaguchi)	1,883,031	Ōi (Fukui)	3,663,598	Takahama (Fukui)	4,349,523
3	Sendai (Kagoshima)	703,595	Onagawa (Miyagi)	1,111,094	Tokai (Ibaraki)	1,471,184	Ōi (Fukui)	1,834,923	Tsuruga (Fukui)	2,576,790	Tokai (Ibaraki)	3,529,320
4	Kashiwazaki Kariwa (Niigata)	393,343	Takahama (Fukui)	852,301	Genkai (Saga)	1,082,480	Mihama (Fukui)	1,793,619	Mihama (Fukui)	2,458,956	Tsuruga (Fukui)	2,679,257
5	Shika (Ishikawa)	389,661	Shika (Ishikawa)	727,336	Tomari (Hokkaido)	1,044,721	Tokai (Ibaraki)	1,282,325	Tokai (Ibaraki)	1,739,802	Mihama (Fukui)	2,517,436
6	Onagawa (Miyagi)	372,913	Tokai (Ibaraki)	658,951	Kaminoseki (Yamaguchi)	1,032,431	Tsuruga (Fukui)	1,187,517	Genkai (Saga)	1,057,456	Fukushima Daiichi (Fukushima)	1,244,685
7	Mihama (Fukui)	365,167	Ikata (Ehime)	633,072	Fukushima Daiichi (Fukushima)	675,818	Genkai (Saga)	927,617	Kaminoseki (Yamaguchi)	918,244	Ikata (Ehime)	989,666
8	Tokai (Ibaraki)	346,269	Fukushima Daiichi (Fukushima)	563,205	Mihama (Fukui)	672,163	Tomari (Hokkaido)	857,342	Hamaoka (Shizuoka)	701,574	Kaminoseki (Yamaguchi)	812,555
9	Tsuruga (Fukui)	330,172	Fukushima daini (Fukushima)	469,405	Tsuruga (Fukui)	589,670	Ikata (Ehime)	781,478	Ikata (Ehime)	699,491	Genkai (Saga)	750,111
10	Fukushima Daiichi (Fukushima)	283,651	Mihama (Fukui)	410,022	Shika (Ishikawa)	582,378	Hamaoka (Shizuoka)	683,611	Sendai (Kagoshima)	496,492	Hamaoka (Shizuoka)	740,136
11	Kaminoseki (Yamaguchi)	228,781	Hamaoka (Shizuoka)	358,959	Kashiwazaki Kariwa (Niigata)	570,945	Fukushima Daini (Fukushima)	422,992	Higashidori (Aomori)	451,154	Fukushima Daini (Fukushima)	529,257
12	Takahama (Fukui)	192,589	Kaminoseki (Yamaguchi)	304,917	Ikata (Ehime)	529,470	Kashiwazaki Kariwa (Niigata)	341,626	Tomari (Hokkaido)	444,486	Kashiwazaki Kariwa (Niigata)	449,289
13	Fukushima Daini (Fukushima)	181,296	Tsuruga (Fukui)	289,520	Fukushima Daini (Fukushima)	491,483	Higashidori (Aomori)	332,559	Fukushima Daiichi (Fukushima)	378,213	Higashidori (Aomori)	342,310
14	Ōi (Fukui)	174,467	Kashiwazaki Kariwa (Niigata)	257,311	Onagawa (Miyagi)	431,412	Ōma (Aomori)	310,104	Fukushima Daini (Fukushima)	337,138	Onagawa (Miyagi)	302,866
15	Tomari (Hokkaido)	142,097	Sendai (Kagoshima)	194,975	Higashidori (Aomori)	341,902	Fukushima Daiichi (Fukushima)	294,956	Kashiwazaki Kariwa (Niigata)	284,026	Ōma (Aomori)	276,985
16	Ikata (Ehime)	117,221	Higashidori (Aomori)	93,455	Hamaoka (Shizuoka)	327,506	Sendai (Kagoshima)	253,518	Onagawa (Miyagi)	214,535	Tomari (Hokkaido)	271,484
17	Ōma (Aomori)	76,416	Tomari (Hokkaido)	80,307	Sendai (Kagoshima)	209,132	Onagawa (Miyagi)	244,521	Ōma (Aomori)	185,802	Sendai (Kagoshima)	222,807
18	Shimane (Shimane)	57,358	Shimane (Shimane)	57,147	Shimane (Shimane)	71,937	Shika (Ishikawa)	196,377	Shimane (Shimane)	149,898	Shimane (Shimane)	147,797
19	Higashidori (Aomori)	46,673	Ōma (Aomori)	34,898	Ōma (Aomori)	48,508	Shimane (Shimane)	162,359	Shika (Ishikawa)	75,602	Shika (Ishikawa)	84,031

Source : Same as Table 1 and Figure 2.

ranking sixth overall and indicating a substantial urban population potentially affected. Other high-ranking sites included Ōi (4.98 million), Takahama (4.47 million), Tokai (3.68 million), Tsuruga (2.71 million), and Mihama (2.53 million). The only location with fewer than 100,000 was Shika (63,000).

These findings strongly suggest that relying solely on a 30 km radius for disaster planning is insufficient. Populations beyond that threshold remain vulnerable and numerous, particularly near metropolitan areas such as Kyoto, Osaka, Kobe, Saitama, Hiroshima and Fukuoka. Moreover, if future nuclear incidents produce contamination zones similar to Fukushima, the current compensation frameworks and evacuation plans would prove inadequate for most other plant locations (Table 6, Table 7 and Table 8).

5. Summary and Future Research Directions

5.1 Summary

This study conducted a comparative population analysis of 19 locations in Japan that host nuclear power plants. Populations were measured based on distance from each plant using both cumulative and zonal aggregation. Seven cumulative distance bands were employed: the Precautionary Action Zone (PAZ, 0–5 km), the conventional evacuation zone (0–10 km), the evacuation order zone from the 2011 Fukushima accident (0–20 km), the Urgent Protective Action Planning Zone (UPZ, 0–30 km), Tani's reference radius (0–50 km), the advisory radius adopted by the U.S. Embassy in Tokyo (0–80 km), and the Chernobyl Exclusion Zone (CEZ, 0–100 km). Zonal breakdowns were further refined into concentric increments such as 3 km, 3–5 km, 5–10 km, and successive 10 km intervals beyond 10 km.

Despite the far-reaching contamination observed in the 2011 Fukushima Daiichi nuclear disaster, Japan's reformed regional disaster prevention plans continue to define the evacuation planning zone strictly within a 30 km radius. This narrow definition fails to include significant population centers outside the designated radius. For instance, even within the 80 km zone recommended by the U.S. Embassy for evacuation after the Fukushima accident, the Fukushima Daiichi region had over 1.98 million residents in 2010—ranking sixth lowest among the 19 sites in population size. Furthermore, sixteen other plant locations exceeded one million people within the same 80 km radius, including Takahama with nearly 6 million.

The current emergency preparedness framework, by restricting official evacuation zones to within 30 km, has the political and administrative effect of limiting the evacuation-eligible population to less than one million even in highly populated regions. For example, the Tokai site—Japan's most densely populated nuclear power plant area—had an estimated 889,000 residents within 30 km in 2020. This containment of potential evacuees aligns with the scale of compensation observed in the Fukushima accident; wherein financial redress was extended only to officially designated forced evacuees.

5.2 Future Research Directions

While this study provides a foundational assessment of spatial population distribution around nuclear power plants, it does not incorporate demographic characteristics such as age, gender, or household composition. Only three census years—2000, 2010, and 2020—were

used, omitting more frequent five-year census data available in Japan. Future research could improve upon this by examining population trends at shorter intervals and analyzing the internal structure of populations in terms of vulnerability indicators (e.g., elderly residents, children, or household density).

Moreover, this study focused exclusively on nuclear power plant sites within Japan. For a more comprehensive and globally contextualized understanding of nuclear disaster risk, it is essential to conduct similar spatial analyses for nuclear facilities in other countries, including the United States, France, China, and South Korea. Comparative studies across national boundaries would reveal the degree to which population exposure varies and would help inform harmonized international standards for evacuation planning and compensation policy in the event of nuclear emergencies.

Note 1: This paper is an English version that has been re-written based on the main part of the study presented in Fujimoto (2025a).

Note 2: This research was supported by JSPS Grant-in-Aid for Scientific Research 22H00031.

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