Process of Choosing the Place of Residence among Households Affected by the Great East Japan Earthquake

International review for spatial planning and sustainable development ,Vol 10 No.3 (2022), 65-83

ISSN: 2187-3666 (online)
DOI: http://dx.doi.org/10.14246/irspsd.10.3_65

Process of Choosing the Place of Residence among Households Affected by the Great East Japan Earthquake

Shoko Araki[1*] and Noriko Akita[2]
1 Graduate school of Engineering, Tohoku University, ORCID: 0000-0002-6312-3169
2 Graduate school of Horticulture, Chiba University, ORCID: 0000-0002-1144-6759
** Corresponding Author, Email: s_araki@tohoku.ac.jp*

Received: *Aug. 26, 2021 ;* Accepted: *May 06,2022*

Keywords: Great East Japan Earthquake, Text mining, Residency decision, Process of decision-making, Kamaishi City, Iwate Prefecture

Abstract: This study aimed to clarify changes in intention from the immediate aftermath of the Great East Japan Earthquake occurred 2011 to the decision to reside in District A, Area U of Kamaishi City, Iwate Prefecture, where a land readjustment project to assist in the restoration of the city's urban areas was introduced after the disaster. This study analyzed data from interviews conducted with residents in 2012 and 2017 using text mining. The analysis revealed that "money," "family," "land," "surroundings," and "community" were important factors in residents' decision to rebuild. In particular, residents in their 60s and 70s exhibited a strong co-occurrence of the word "everyone," indicating that they chose their place of residence based on their surroundings. The word "neighborhood association" appeared in 2017 and indicated the importance of "community" in the residents' decision to rebuild. Because neighborhood association in District A was active even before the earthquake. The results showed that the activities of the neighborhood association, which was the center of the community before the earthquake, once again served as a cordon and tether, and functioned as a mechanism to incorporate the opinions of households that had left the district.

1. INTRODUCTION

In March 2011, the Great East Japan Earthquake occurred. The magnitude of the earthquake was 9.0 on the Richter scale, with a maximum intensity of 7 on the Japanese scale. The earthquake triggered a tsunami along the entire Pacific coast of Japan, with a maximum wave height of over 9.3 meters observed. A total of 1,155,100 homes were completely or partially destroyed, and 11,275 homes were flooded (FDMA, 2022).

The reconstruction period was estimated to be 10 years starting in 2011. As of 2022, the project was completed. Since the areas inundated by the tsunami were damaged on all sides, each municipality where houses were damaged supported the reconstruction of homes and revitalization of towns by utilizing the Urban Area Reconstruction Project. There were three main types of urban area reconstruction projects: (α) Disaster Prevention Group

Relocation Promotion Project, (β) Urban Area Reconstruction Land Readjustment Project, and (γ) Tsunami Reconstruction Base Improvement Project.

The Disaster Prevention Group Relocation Promotion Project supported the collective relocation of residents in areas that were damaged or had a high risk of flooding and were deemed unsuitable for residential use. The municipality developed housing complexes at relocation sites on higher ground, purchased the original sites affected by tsunami, and provided subsidies for moving expenses. This project was introduced in 321 districts.

The Urban Area Reconstruction Land Readjustment Project supported the systematic and integrated development of public facilities and residential land for the reconstruction of urban areas. This project was established by the Law on Special Measures for Reconstruction of Urban Areas Affected by the Great Hanshin-Awaji Earthquake of 1995 (MLIT, 2021). In the Great East Japan Earthquake, this project was also introduced in 50 residential and 15 non-residential districts.

The Tsunami Reconstruction Base Improvement Project urgently developed public facilities in urban areas intended to serve as reconstruction bases. This project was introduced in 24 districts.

These projects have now been completed. However, gaps between projects and actual demand have been identified, as evidenced by the declining population in areas where the projects were implemented and appearance of vacant lots due to the lack of residents in the developed areas. The reasons for this were the long time require to complete the projects, with residents being unable to wait, and issues with the method of surveying residents' intentions to rebuild.

Project β was implemented in 20 districts in Hyogo Prefecture during the reconstruction after the Great Hanshin-Awaji Earthquake in 1995, which triggered the introduction of the disaster-stricken urban area reconstruction land readjustment project; however, the project was completed in 2011, 16 years after the earthquake (Hyougo-Pref, 2011). It has been pointed out that this was not feasible in the affected urban areas where land prices were not expected to rise due to stagnant development after the earthquake (Jitsu., 2000).

After the Great East Japan Earthquake, each municipality conducted a questionnaire survey to identify victims' intentions to rebuild their homes and decided the number of units to be built based on the results, particularly for public housing for reconstruction. Affected municipalities in Iwate Prefecture conducted a total of four surveys in 2011 and 2012, respectively (Meno, 2013). It has been pointed out that the municipality needed to adjust the number of housing units based on residents' changed intentions due to the time gap between the initial intention survey and actual construction Tsukuda2017(Tsukuda, Yamanobe et al., 2017). After the earthquake, residents were forced to choose where to live as the government decided the policies of the reconstruction project.

A study in the field of psychology (Sakai and Atsumi, 2020) conducted a longitudinal interview survey of disaster-affected residents over a period of seven years and analyzed the results by overlapping the time axis using the method of depicting the psychological change line. The results revealed that when residents became socially isolated, the presence of family members and people close to them was important and key to the recovery process.

This study conducted interviews annually between 2012 and 2019 with residents affected by the Great East Japan Earthquake in one of the U areas of Kamaishi City (District A), Iwate Prefecture, where projects β and γ were

implemented. During the survey process, discrepancies were identified between responses to the local government's intention survey and actual intentions of the residents. Also, it revealed that "money," "family," and "land" were significant factors in residents' residing intentions (Araki, S., Akita et al., 2019). Therefore, this study aimed to clarify changes in intentions of disaster-affected residents from the time immediately after the Great East Japan Earthquake to the point of choosing the place of residence based on the timeline of the decision, progress of reconstruction projects, and resident attributes, such as age and place of residence. The novelty of this study is that it analyzed text data of actual statements made by residents affected by the disaster at different points in time.

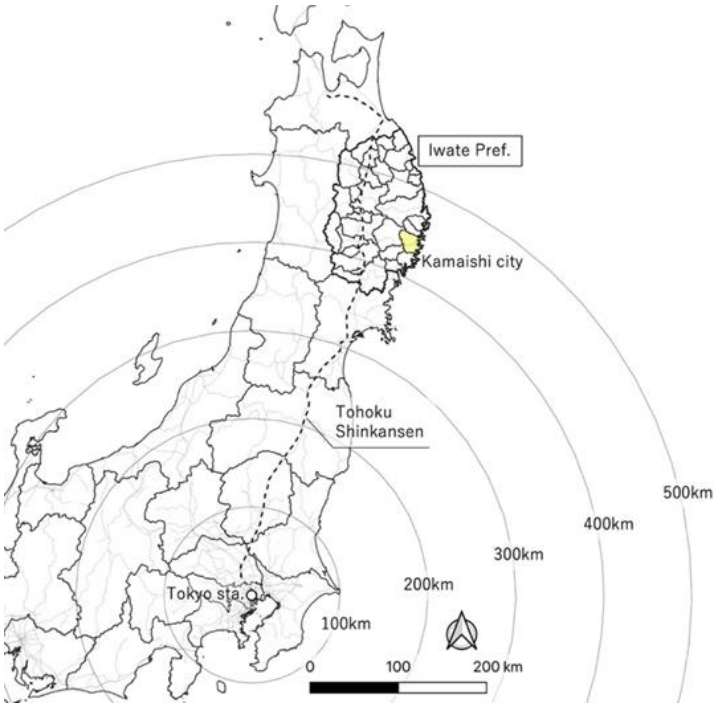

Figure 1. Map of Kamaishi city
Source: MLIT, 2021

2. MATERIALS AND METHODS

2.1 Study Area

The city of Kamaishi, Iwate Prefecture, is in the south-eastern part of the prefecture *(Figure 1*). Kamaishi is approximately 400 km away from Tokyo. It has a ria coast area. The city developed from the fishing and steel industries. The population was 39,574 people and 16,094 households in 2010, which decreased to 32,096 people and 14,723 households in 2020 (National-Census, 2015, 2020).

At the time of the Great East Japan Earthquake, Kamaishi City experienced a seismic intensity of 6 lower on the Japanese scale (magnitude 9.0), resulting in 994 deaths and 152 missing people (FDMA, 2022). Tsunami waves of up to 9.3 meters were observed (Kamaishi-City, 2021b), and 7 km^2 of the city area of 443 km^2 was inundated (Kamaishi-City, 2012).

This study focused on one district (District A), which is a neighborhood association unit located in Area U, approximately 10 km away from the center of Kamaishi City. *Figure 2* shows a map of the area around Area U. The

population of Area U was 3,774 people and 1,526 households in February 2011, and 1,743 people and 870 households in February 2021, with a -53.8% population change rate (Kamaishi-City, 2021a). District A is in the southern part of Area U, facing the river and surrounded by mountains. The area has been developed as a bed town for Kamaishi City since the 1960s, when businesspeople who worked at the center of Kamaishi began to live in the area in search of housing. Most of the residents in District A belonged to A Neighborhood Association, which was established in 1981 and had approximately 220 member households in 2010. Twenty-nine people died in the Great East Japan Earthquake.

A Neighborhood Association was characterized by its festivals and other events, and by strong ties between residents (Nishino, Ishikura et al., 2013).

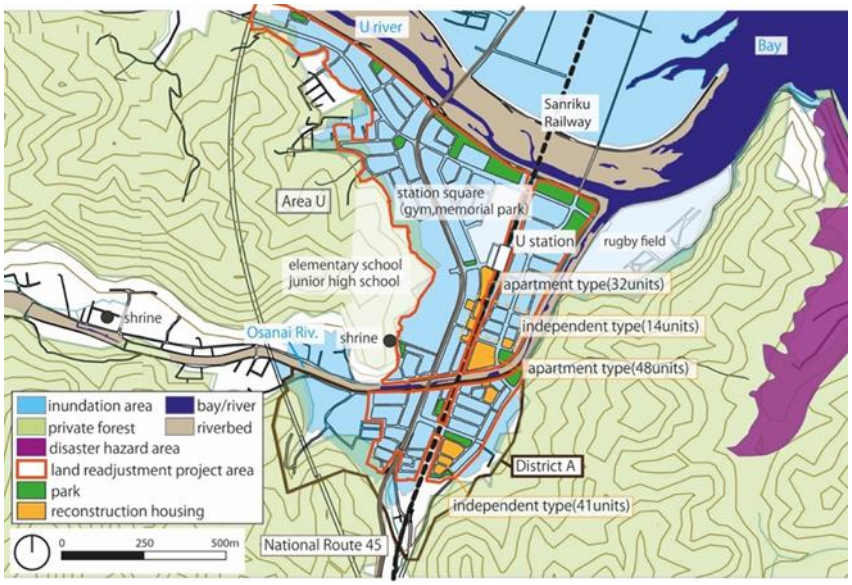

Figure 2. Map of Area U
Source: GSI, 2016; Kamaishi-City, 2012

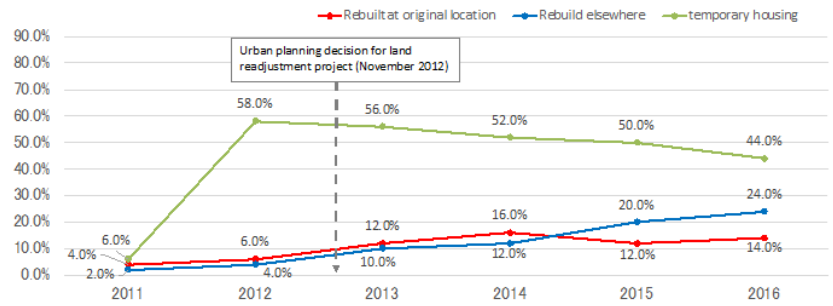

Figure 3. Residential migration of surveyed households in the project area

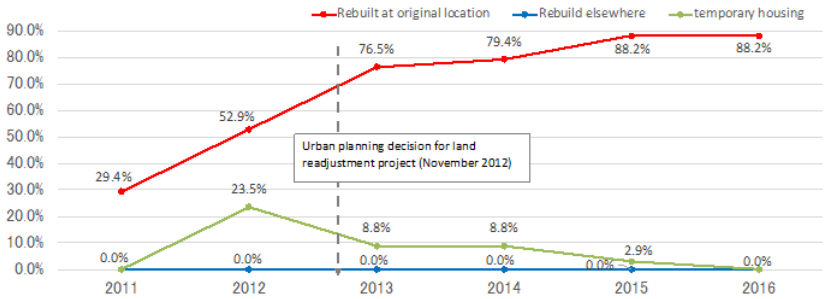

Figure 4. Residential migration of surveyed households outside the project area

District A implemented two of the projects described above: β Urban Area Reconstruction Land Readjustment Project and γ Tsunami Reconstruction Base Improvement Project. In District A, approximately two thirds of the households and approximately 40% of land area of District A was covered by these projects since the city planning decision was made in November 2012. *Figures 3* and *4* show the reconstruction rate from 2011 to 2016 for households inside and outside the rezoning project area, respectively. Some of the households that were subject to the project relocated and rebuilt elsewhere without waiting for the project, while others were in temporary housing waiting for the project. More than 80% of the households outside the project area were rebuilt in their original locations. The implementation of the project had a significant impact on their residential patterns and policies (Araki, Shoko and Akita, 2017).

Table 1 shows a timeline of events in Kamaishi City since the Great East Japan Earthquake. In December 2011, Kamaishi City formulated the Basic Plan for Reconstruction and Urban Development, which laid out the basic policies for urban development (Kamaishi-City, 2012). In 2017, the damaged elementary and junior high schools were rebuilt on higher ground. In March 2015, a decision was made to bring the Rugby World Cup to Kamaishi City, and a new rugby stadium was built on the site of a damaged elementary and junior high school (Kamaishi-Unosumai-Memorial-Stadium). Kamaishi City has a long history of rugby. The steelworks, which was the catalyst for Kamaishi's development, formed a rugby team in 1959, and by 1970, the team had won many Japanese championships. However, the rugby team's performance thereafter was poor, the steel industry entered a period of stagnation, and the era of steel and rugby in Kamaishi came to end.

However, after the earthquake and tsunami, momentum built to bring rugby back to Kamaishi as a symbol of reconstruction, and the World Cup was invited to the city.

In 2018, the construction of the rugby stadium was completed. The area around U Station was transformed with the reopening of the railway, the construction of memorial facilities, lore, and tourism facilities, and it served as a place to entertain players and guests during the 2019 Rugby World Cup.

Table 1. Events after the earthquake in Kamaishi City

Year	Month	Event
2011	3	the Great East Japan Earthquake occured
	8	Completed moving into temporary housing. Shelters completely closed
	12	Reconstruction Town Development Basic Plan was published
2012	7	Designation of urban disaster recovery promotion area
	8	Hearing survey by our team
	11	Land readjustment project formation facility in a housing complex
2013	3	Land readjustment project business area decision and designated
	5	Started moving into public housing
2014	6	Completed designation of temportrary replotting
2015	8	Summer festival in District A restart
2016		-
2017	4	New elementary school and junior high school at Area U restart
	9	Hearing survey by our team
	9	Reconstruction housing completed move-in completed
2018	8	Rugby stadium (Kamaishi Unosumai Memorial Stadium) opend
	12	Completed moving into public housing
2019	3	Sanriku railway restart
	3	Completed facilities around U Station
	7	Temporary housing specific extension decision
	9	2019 Rugby World Cup holded

2.2 MATERIAL AND METHODS

This study conducted an interview survey and analyzed the data using text mining techniques.

2.2.1 Summary of the Interview Survey

Interviews were conducted with residents every summer from 2012 to 2019. The targeted residents were those who were living in District A at the time of the earthquake. Participants were referred by their community associations. Semi-structured interviews lasting one to two hours were conducted with the heads of households and their spouses. All interviewees agreed to provide their personal data in advance.

The participants were asked regarding their opinions, plans for housing reconstruction, and hopes for the city's urban planning. The following questions were used:

- How did you evacuate when the earthquake occurred? (First interview only)
- Where and how did you live during the subsequent evacuation? (First interview only)
- Was there a point in time when you thought you had reached a break? Have your feelings changed?

- Have there been any changes in housing, work, family, or health status between the last interview and now?
- Do you currently have any wishes or problems?
- Where and how do you plan to reside in the future?
- What do you think are the biggest current and future challenges for Area U and Kamaishi City?
- What do you currently feel most strongly about?

2.2.2 Overview of Text Mining

The text data obtained from the interviews were extracted without identifying individuals. Data were compiled by year into a single report and distributed to the participants. Text data of the statements excerpted in the report were used for the present analysis. The excerpts were modified from spoken to written form and furthermore were conducted to avoid duplication of content. We have also removed portions that interviewees did not wish to be made public.

This study used data from 2012 and 2017 for comparison and analysis (*Table 1*, indicated in grey). These years were chosen because 2012 was the first year of the survey and collected residents' opinions immediately after the disaster and the 2017 report was published at the time of the present analysis. In 2017, which was the halfway point of the ten-year construction plan, the reconstruction had progressed, and changes could be seen in the city. As interviews were conducted every summer, the data were from August 2012 and September 2017.

This study used KH Coder, a text mining software, to analyze interview data (Higuchi, K., 2016). As of 2017, KH Coder has been used in more than 1,500 cases to analyze text data from a wide range of genres, including SNS, mass media, and social surveys (Higuchi, Koichi, 2017). In particular, studies analyzing interview data have compared groups with different conditions and examined the relationship between them by setting psychological and social factors (Takeda and Watanabe, 2012).

A previous study on used KH Coder to examine words related to the Great East Japan Earthquake in extracted articles from national and local newspapers and analyze them by personal attributes (Fujimori, Koyama et al., 2014). Other studies analyzed social networking sites (Goto and Sakai, 2017) and the experiences of volunteer students after the earthquake (Shimoyama, Sugawara et al., 2021).

A wide range of text mining studies have used KH Coder for information reported in the media and speech records of volunteers. However, speech records of actual disaster victims have not been analyzed in detail; therefore, this study was conducted.

This study investigated changes in the content of speech over time and the relationship between the content of speech and the age of the speaker. Because the age at the time of the statement was an important factor. In the analysis of utterances, compound words detected using "Chasen", morphological analyzer and inconsistent identical words were specified as words to be forcibly extracted, and preprocessing was performed. This is to clarify the separation of words to be extracted. The word "think" is often connected to the end of words in interview surveys; however, it was excluded from the present analysis, as it does not have an important meaning. In addition, particles with no individual meaning were excluded. Other words were not excluded, as they were important for understanding the relationship between words in a sentence.

This analysis was conducted in Japanese. As most Japanese word has several meanings, English words with the nearest meaning are used in the present report along with the Japanese originals.

3. ANALYSIS OF CONVERSATION RECORD

3.1 High Frequency Words Analysis

Table 2 shows the number of participants, paragraphs, and words calculated by KH Coder. Twenty-three participants and 90 statements were analyzed in 2012, and 31 participants and 379 paragraphs (statements) were analyzed in 2017. Participants began by being introduced by their neighborhood associations, but the number of participants fluctuated depending on their willingness to participate and their availability when scheduling the survey in previous years. A group of paragraphs refers to the statements made by the same participant on a single topic. In addition, 13 of these were the same participant, which means that a total of 41 instances of text data were used. The amount of data available in 2012 was small because it was the first year of the survey, the lack of sufficient trust with the residents, and the emotional state of the residents immediately after the earthquake.

The analysis extracted 20,388words in 2012, of which 7,036 were analyzed after excluding particles. The number of overlapping words in 2012 was 1,825, of which 1,499 were analyzed. In 2017, the total number of extracted words was 70,834, of which 24,834 were analyzed. The number of overlapping words in 2017 was 4,507, of which 3,975 were analyzed.

Table 2. The number of words to be analyzed

Types	2012	2017
Number of people analyzed	23 ※13 are duplicates	31
Number of paragraphs analyzed	90	379
Total number of extracted words	20,388	70,834
Number of words to be analyzed out of total extracted words	7,036	24,652
Number of different words	1,825	4,507
Number of words to be analyzed among different words	1,499	3,975

.

Table 3. Top 100 words of 2012

No	words	times
1	people(人)	144
2	good(良い)	129
3	say(言う)	117
4	construct(建てる)	82
5	now(今)	68
6	everyone(みんな)	65
7	house(家)	62
8	Kamaishi City(釜石市)	62
9	temporary housing(仮設住宅)	56
10	Area U(U地域)	54
11	think(考える)	47
12	come(来る)	47
13	return(戻る)	46
14	go(行く)	43
15	live(住む)	38
16	go back(帰る)	34
17	city hall(市役所)	34
18	go out(出る)	33
19	early(早い)	33
20	District A(A地区)	31
21	place(場所)	30
22	land(土地)	30
23	come in(入る)	30
24	feeling(気持ち)	28
25	reconstruction housing(復興公営住宅)	28
26	children(子どもたち)	26
27	really(本当に)	26
28	we(私達)	24
29	child(子ども)	23
30	story(話)	23
31	first(一番)	22
32	impression(感じ)	22
33	local(地元)	22
34	former(元)	21
35	myself(自分)	21
36	go out(出す)	20
37	various(いろいろ)	19
38	school(学校)	19
39	hard(大変)	19
40	town(町)	19
41	elderly people(高齢者)	18
42	tsunami(津波)	18
43	hear(聞く)	18
44	no good(ダメ)	17
45	reconstruction(復興)	17
46	relief(安心)	16
47	see(見る)	16
48	completely(全然)	16
49	appear(見える)	15
50	inland(内陸)	15
51	necessary(必要)	15
52	young(若い)	14
53	anxiety(不安)	14
54	land readjustment(区画整理)	13
55	first(最初)	13
56	life(生活)	13
57	road(道路)	13
58	when(いつ)	12
59	evenrually(結局)	12
60	gather(集まる)	12
61	can live(住める)	12
62	ahead(先)	12
63	previous(前)	12
64	buy(買う)	12
65	change(変わる)	12
66	somehow(何とか)	11
67	decide(決まる)	11
68	be built(建つ)	11
69	thought(思い)	11
70	have(持つ)	11
71	voice(声)	11
72	fine(大丈夫)	11
73	seawall(防潮堤)	11
74	1year(1年)	10
75	JR	10
76	loan(ローン)	10
77	reverse(逆)	10
78	a little(少し)	10
79	case(場合)	10
80	absolute(絶対)	10
81	many(多い)	10
82	escape(逃げる)	10
83	calm down(落ち着く)	10
84	together(一緒)	9
85	temporary(仮設)	9
86	money(金)	9
87	"Toramai"(虎舞)	9
88	do(行う)	9
89	job(仕事)	9
90	we(自分たち)	9
91	take(取る)	9
92	hand(手)	9
93	residents(住民)	9
94	fix(直す)	9
95	insert(入れる)	9
96	suffering from(被災)	9
97	scare(怖い)	9
98	10years(10年)	8
99	volunteer(ボランティア)	8
100	make effort(頑張る)	8
101	can go back(帰れる)	8
102	plan(計画)	8
103	age(歳)	8
104	use(使う)	8
105	new(新しい)	8
106	progress(進む)	8
107	wait(待つ)	8
108	region(地域)	8
109	earthquake(地震)	8
110	Tokyo(東京)	8
111	inland area(内陸部)	8

KH Coder was used to extract the top 100 most frequently occurring words in 2012 and 2017. In cases where a word appeared the same number of times as the 100th word, all words with the same number of times were listed.

Table 3 shows the results for 2012. In December 2011, Kamaishi City formulated the Basic Plan for Reconstruction and Urban Development, which outlines the basic policies for urban development. For this reason, in the 2012 survey, many respondents expressed their expectations and concerns about the future of the city, with words such as “relief” (No. 46 and “anxiety” (No. 53) indicating their feelings. In addition, there was dissatisfaction with “city hall” (No. 17), concern about the state of infrastructure, such as “school” (No. 38), “road” (No. 57), and “seawall” (No. 73), and anxiety about money, such as “loan” (No. 76).

At the time of the survey, the city had not yet decided on its urban planning but was scheduled to do so in several months. “Land readjustment” (No. 54) was frequently mentioned, as was “construct” (No. 4), “house” (No. 7), and “return” (No. 13), all of which were top-ranked words. Many respondents expressed hesitation regarding whether they would return to the same place as before the earthquake.

"City hall" referred not to the concept of location but to criticisms and requests expressed to the government as the government decided what reconstruction projects to proceed with. Residents were unsure whether they would be able to live on their own land again and were considering whether to rebuild in their original locations or live in public housing for reconstruction, feeling anxious about their financial and family situations.

Table 4. Top 100 words of 2017

No	words	times
1	people(人)	566
2	good(良い)	347
3	say(言う)	264
4	now(今)	231
5	come(来る)	230
6	house(家)	204
7	construct(建てる)	169
8	go out(出る)	164
9	Area U(U地域)	163
10	go(行く)	148
11	come in(入る)	144
12	Kamaishi City(釜石市)	127
13	temporary housing(仮設住宅)	110
14	reconstruction public housing(復興公営住宅)	110
15	everyone(みんな)	109
16	child(子ども)	103
17	story(話)	100
18	land(土地)	98
19	see(見る)	92
20	impression(感じ)	88
21	think(考える)	88
22	previous(前)	84
23	really(本当に)	84
24	early(早い)	80
25	hard(大変)	80
26	various(いろいろ)	73
27	we(私達)	73
28	myself(自分)	72
29	live(住む)	71
30	hear(聞く)	68
31	first(一番)	67
32	neighborhood association(町内会)	62
33	return(戻る)	58
34	school(学校)	57
35	town(町)	55
36	no good(ダメ)	53
37	have(持つ)	52
38	District A(A地区)	51
39	difference(違う)	48
40	job(仕事)	48
41	tsunami(津波)	48
42	place(場所)	47
43	road(道路)	45
44	be built(建つ)	44
45	first(最初)	44
46	many(多い)	44
47	walk(歩く)	43
48	feeling(気持ち)	42
49	make(作る)	42
50	reconstruction(復興)	42
51	change(変わる)	42
52	go out(出す)	41
53	everything(全部)	41
54	1year(1年)	40
55	city hall(市役所)	40
56	region(地域)	40
57	festival(お祭り)	39
58	and(と)	38
59	go back(帰る)	38
60	next time(今度)	38
61	young(若い)	38
62	previous(以前)	36
63	decide(決まる)	36
64	very(結構)	36
65	know(知る)	36
66	construction(工事)	35
67	children(子どもたち)	35
68	life(生活)	35
69	appear(見える)	34
70	water(水)	34
71	when(いつ)	33
72	high(高い)	33
73	elderly people(高齢者)	33
74	end(終わる)	33
75	gather(集まる)	33
76	earthquake disaster(震災)	33
77	past(昔)	33
78	escape(逃げる)	32
79	condition(状態)	31
80	decide(決める)	30
81	decrease(減る)	30
82	go ahead(進む)	30
83	2017(2017年)	29
84	handover(引き渡し)	29
85	rebuild(再建)	28
86	use(使う)	28
87	big(大きい)	28
88	delay(遅れる)	28
89	apartment(アパート)	27
90	hope(希望)	27
91	car(車)	27
92	new(新しい)	27
93	finally(結局)	26
94	age(歳)	26
95	completely(全然)	26
96	6years(6年)	25
97	money(お金)	25
98	town planning(まちづくり)	25
99	impossible(ムリ)	25
100	together(一緒)	25
101	very hard(一生懸命)	25
102	inland of Kamaishi(釜石中心部)	25
103	insert(入れる)	25

Table 4 shows the results for 2017. In November 2012, Kamaishi City decided to implement the land readjustment project, which covered two thirds of the households and approximately 40% of the district area in District A. At this point, the residents knew whether their house was in the land readjustment project zone or outside of it. Households in the project area could rebuild but would have to wait for some time in other housing, such as temporary housing. Some of the households in the project area decided to stop waiting and rebuild on their own outside the project area due to concerns regarding their health and age, and some decided to move into public housing for reconstruction.

In 2016, it was decided that the JR line in Area U would be transferred to Sanriku Railway and restarted. In April 2017, reconstruction progressed with the reopening of elementary and junior high schools that had been relocated to higher ground and newly built. Newly extracted words in 2017, as reconstruction progressed, included "neighborhood association" (No. 32), whose activities in District A resumed in earnest, and "festival" (No. 57), which was revived in 2015 mainly by the neighborhood association. The "festival" is a traditional event that has been passed down within the

neighborhood association and is intended to deepen the friendship among the residents. In addition, feelings of "delay" (No. 88), "end" (No. 74), and "hope" (No. 90) and comments regarding "decrease" (No. 81) and "handover" (No. 84) of land related to the land readjustment project were often mentioned. The residents had hopes and concerns regarding the information and situation around them at the time relating to the reconstruction process. As mentioned above, various factors, such as family, age, and physical condition, affected residents' decisions regarding place of residence.

The top words were "people" (No. 1), "good" (No. 2), "say" (No. 3), and "now" (No. 4), as in 2012. In addition to "temporary housing" (No. 13), "reconstruction public housing" (No. 14) was mentioned, and along with "house" (No. 6) and "build" (No. 7), which were mentioned frequently since 2012. Many words related to housing were recorded, indicating that residents were concerned with rebuilding their homes and where to live.

3.2 Co-occurrence Network Analysis

3.2.1 Overall trends

To see the relationship between words, co-occurrence networks were used and the main extracted words were grouped using 2012 and 2017 text data. *Figure 5* shows the co-occurrence network diagram for the top 60 words. The elements of the co-occurrence network were categorized into seven groups, and the representative extracted words of each group were selected and organized as group names (*Table 5*). The results of classification of all text data using co-occurrence networks by year of utterance, 2012 and 2017, were utilized. The co-occurrence network for each year was created, and the top co-occurring words were marked with ○.

Group 1 included words such as "everyone" and "people," Group 2 included words such as "say" and "live," which referred to the actions of oneself and others, and Group 7 included words such as "house," "build," and "land," which referred to self-reconstruction.

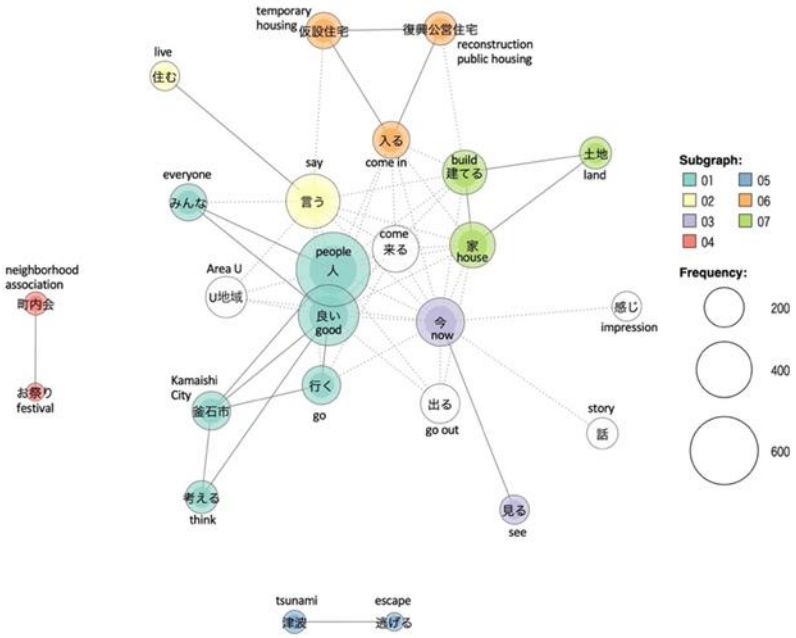

Figure 5. Co-occurrence network diagram

Table 5. Grouping of co-occurring network elements

	group name	words	co-occurrence	
			2012	2017
1	everyone	people(人)	○	○
		good(良い)	○	○
		everyone(みんな)	○	○
		go(行く)	○	○
		Kamaishi City(釜石市)	○	○
		think(考える)	○	○
2	live	say(言う)	○	○
		live(住む)	○	○
3	now	now(今)	○	○
		see(見る)		○
4	neighborhood association	neighborhood association(町内会)		
		festival(お祭り)		
5	tsunami	tsunami(津波)	○	
		escape(逃げる)		
6	temporary housing	temporary housing(仮設住宅)	○	○
		recoustruction housing(復興公営住宅)		○
		come in(入る)		○
7	build	house(家)	○	○
		build(建てる)	○	○
		land(土地)	○	○

In 2012, “tsunami” of Group 5 co-occurred. In 2017, “see” of Group 3 and “reconstruction public housing,” and “enter” of Group 6 strongly co-occurred, indicating that the utterances changed according to the reconstruction process. For Group 6, which indicated the place of residence, “temporary housing” co-occurred in 2012, and “temporary housing,” “reconstruction public housing,” and “enter” co-occurred in 2017. This was likely due to an increase in occupancy of public housing for reconstruction in 2017, as it was completed in December 2018. Group 4, which included “neighborhood association” and “festival,” did not show strong co-occurrences in either 2012 or 2017. Although these two words did not directly refer to the place of residence and were somewhat scarce in the total number of statements.

Next, to examine the detailed speech trends in 2012 and 2017, an analysis was conducted using two co-occurrence networks by age and residence of the respondent.

3.2.2 Speech trends by age

Figures 6 and *7* show the co-occurrence network diagrams for the tendency of utterances by respondent age for 2012 and 2017, respectively. In 2012, the words "people," "good," "return," and "say" co-occurred most strongly, with "people" and "good" co-occurring among people in their 40s, 60s, and 70s, "return" co-occurring among people in their 30s, 40s, and 70s, and "say" co-occurring among people in their 40s, 50s, and 60s. "People" and "good" co-occurred among people in their 40s, 60s and 70s, "return" among people in their 30s, 40s and 70s, and "say" among people in their 40s, 50s and 60s. In particular, the words "everyone" and "temporary housing" co-occurred strongly among respondents in their 60s and 70s, and many of them were concerned about the actions of others and their families when deciding where to live. Among those in their 30s and 40s, words such as "children" and "loans" co-occurred in 2012 and "children" and "school" in 2017, indicating that they were concerned about their families and money situations. Among those in their 70s and 80s, "city hall" and "land" co-occurred in 2012, and "construction," "road," and "land" in 2017, indicating that they were concerned about the environment around their homes and their age. In rural areas of Japan, there is a strong belief that the property of land is passed down from generation to generation (Yoshimura, 2011). As such, even if the location of one's land is changed through land readjustment projects, there is strong resistance to giving up one's land. Therefore, many people, especially elderly households, intended to keep their "land" in case their "children" return to Kamaishi City.

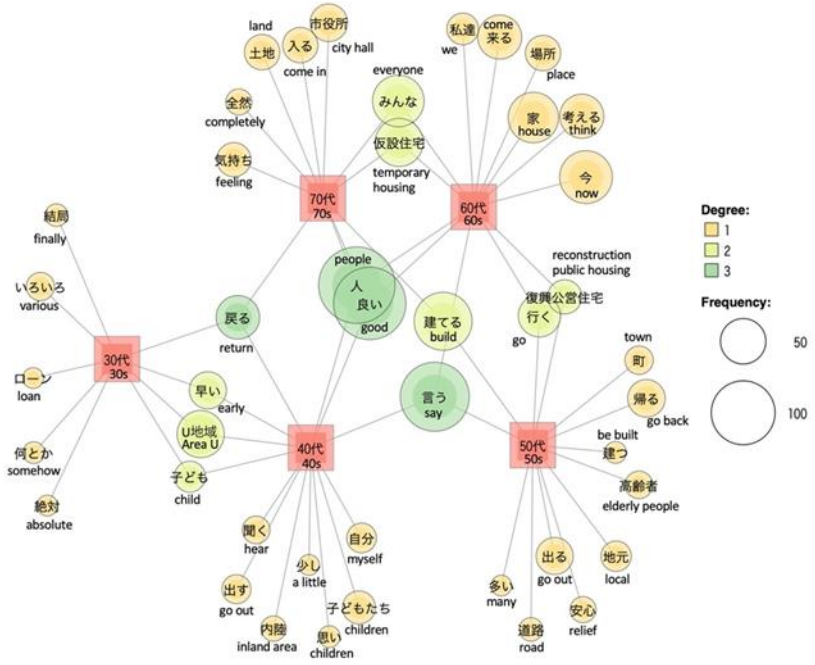

Figure 6. Co-occurrence network diagram by age in 2012

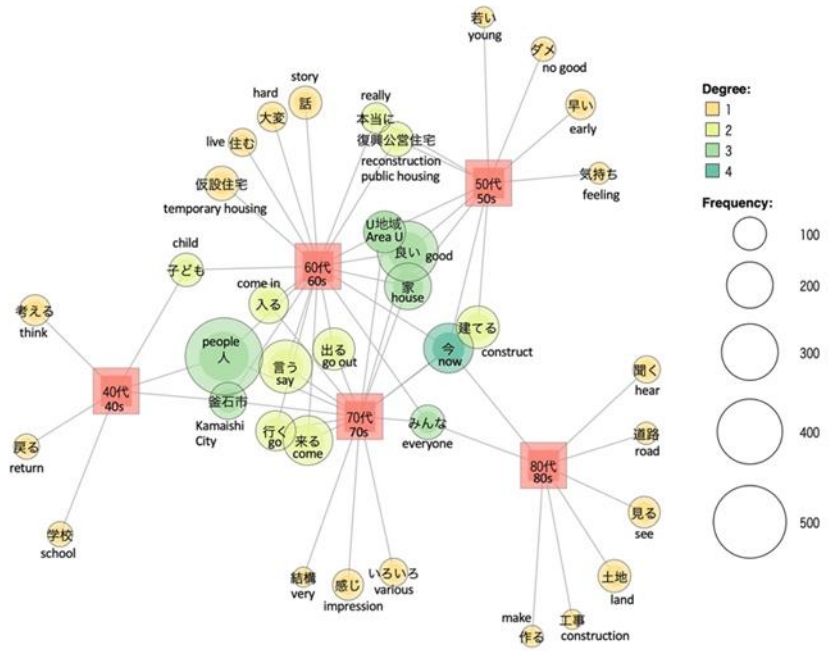

Figure 7. Co-occurrence network diagram by age in 2017

Although the targets differed depending on the age of the respondents, there was a tendency to remark on neighbors, family, and the surrounding environment. Residents decided where to live while paying attention to the actions of other residents who lived in the neighborhood before the earthquake. This could be due in part to the fact that District A had a strong neighborhood association community.

3.2.3 Speech trends by residence

Figure 8 shows the range of places of residence. The category outside of Kamaishi City included most of the cities, towns, and villages in Iwate Prefecture surrounding Kamaishi City as well as some households that moved to Tokyo.

Residents outside of Kamaishi City were mainly households that rebuilt on their own or moved in with family members who had been living separately. Most of the households continued to care about Kamaishi City and District A even after moving out.

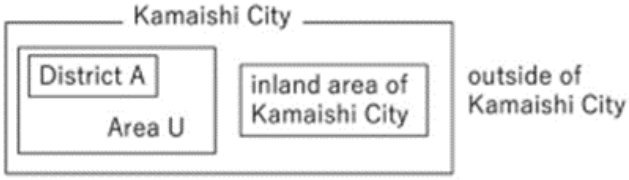

Figure 8. Location of residence

Figures 9 and *10* show the co-occurrence network diagrams for 2012 and 2017, respectively. The words “return” and “going back” co-occurred among households living in inland Kamaishi in 2012 but not in 2017. In 2012, “temporary housing” co-occurred in inland Kamaishi and Area U, and “reconstruction public housing” co-occurred in inland Kamaishi; however, in 2017, “temporary housing” and “reconstruction public housing” co-occurred in both inland Kamaishi and Area U. In addition, in 2012, “house” and “build”

co-occurred in inland Kamaishi and Area U, whereas in 2017, “house” co-occurred in inland Kamaishi, Area U, and Area A, and “build” co-occurred in Areas U and A. “Land” co-occurred in inland Kamaishi and outside of Kamaishi City in 2012 and in region U and outside of Kamaishi City in 2017.

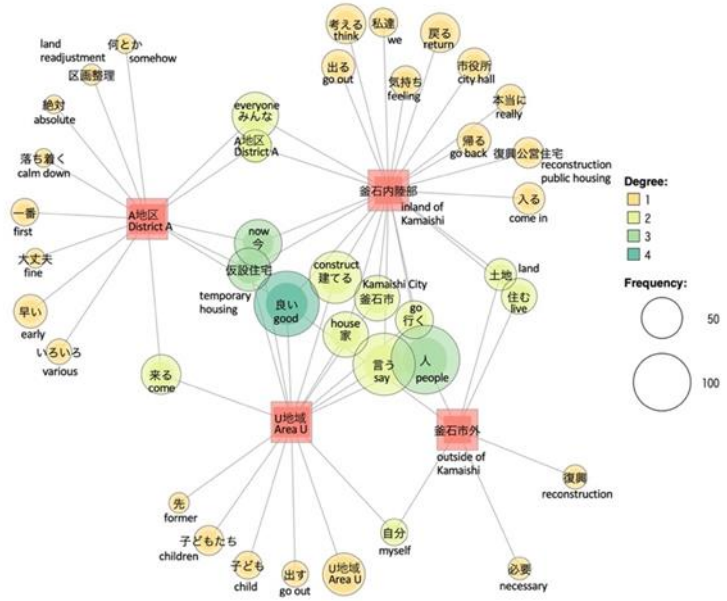

Figure 9. Co-occurrence network diagram by residents for 2012

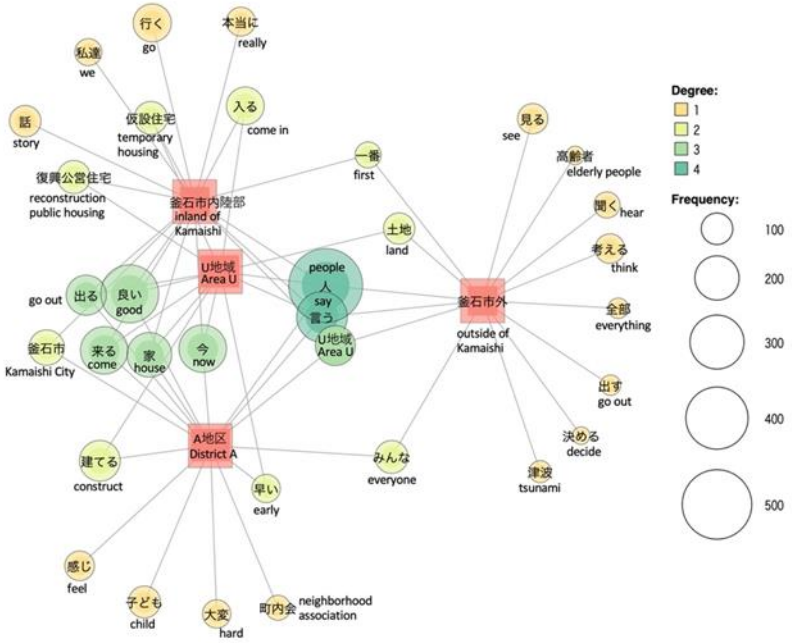

Figure 10. Co-occurrence network diagram by residents for 2017

In 2017, the “neighborhood association” was co-founded by the residents of District A, indicating that the association, which was active before the disaster, was importance during the six years after the disaster. Consequently, the neighborhood association resumed. This may have been due to the progress of the land readjustment project and the prospect of rebuilding within Area U and District A.

As mentioned above, the word “tsunami,” which co-occurred in 2012, strongly co-occurred outside Kamaishi City in 2017. This indicates that

residents who left Area U and District A were still concerned about the memory of the tsunami even after five years had passed, and that they left Kamaishi City and moved inland. In addition, the word "everyone" co-occurred with District A and Kamaishi inland in 2012 and District A and outside of Kamaishi City in 2017. Residents who remained in District A were aware of the people around them to maintain the community they had before the disaster. In addition, the A Neighborhood Association continued to maintain ties after the earthquake by sending newsletters to residents who had originally belonged to the neighborhood association. Among residents who left Kamaishi City, some people felt sadness and guilt about leaving Kamaishi City.

4. DISCUSSION

The co-occurrence relationship between the words in 2012 and 2017 revealed that residents had hopes and fears based on the information at the time and their surroundings, depending on the state of recovery. Words related to reconstruction strongly co-occurred depending on the year. In particular, immediately after the earthquake, many complaints about city hall co-occurred, whereas in 2017, words related to community, such as neighborhood association, and reconstruction of public housing co-occurred, indicating a positive attitude toward reconstruction.

"Everyone" co-occurred in both 2012 and 2017. Residents continued to be concerned about the actions of others during rebuilding and deciding where to live. The word "everyone" co-occurred strongly, particularly among people in their 60s and 70s. This suggests that they tended to be concerned about the actions of others, their families, and their surroundings. Words regarding rebuilding indicated that residents were constantly faced with a variety of choices, such as whether to leave District A and whether to rebuild or move into public housing for reconstruction. The government's housing construction policy changed from hour to hour, and the timing of the explanatory meetings for residents and the timing of the intention survey were also irregular. It became clear that it was difficult for them to make decisions on their own, and that they were influenced by the situation around them and changes in the reconstruction project.

In 2012, households in the inland of Kamaishi that had left District A were considering returning to District A to rebuild. By 2017, many of these households had already decided on a place to live. In 2012, the households living in the inland areas of Kamaishi were divided into two groups: those that had returned to District A or Area U and those that had set up residence in the inland areas of Kamaishi. However, even households that left District A and moved their residence outside of Kamaishi continued to think about the land they left behind and the tsunami. Residents who had left Kamaishi City exhibited co-occurrences of the words "tsunami" and "everyone" and were aware of their experiences in District A and their pre-disaster community.

These results indicated that residents (1) had hopes and fears depending on the state of reconstruction, (2) were continuously concerned about others and their surroundings when deciding how to rebuild, and (3) were continuously concerned about their pre-disaster residence regardless of decisions to rebuild in the same location.

5. CONCLUSION

In Japan, large-scale earthquakes that trigger tsunamis, such as the Nankai Trough earthquake and an earthquake directly under the Tokyo metropolitan area, are expected to occur within the next 20 years. The scale of damage is expected to be more devastating than the Great East Japan Earthquake, which was examined in this study. As an island nation surrounded by mountains and the sea, Japan faces the challenge of ensuring safety for residents on its limited low-lying land while enjoying the benefits of the sea. This study is expected to be useful in analyzing the residents' speech regarding relocation within a limited area. The results of this study are expected to be useful.

This study aimed to clarify the change in the decision-making process of the residents affected by the Great East Japan Earthquake from the immediate aftermath of the disaster to choosing the place of residence. This study examined the chronological order of decision-making, progress of the reconstruction project, and resident attributes. The results of an interview survey in District A in Kamaishi City, where a land readjustment project was implemented, were analyzed using text mining.

Previous studies revealed that “money,” “family,” and “land” were significant factors in residents’ rebuilding intentions. In the present survey, “children” and “loan” were co-occurring factors, especially among residents in their 30s and 40s, and “land” was a co-occurring factor for residents in their 70s and 80s. This indicated that residents decided where to rebuild while considering their family situation and the succession of land (property).

In addition, this study focused on the attributes of the respondents, particularly their place of residence and age, and found that “surrounding conditions” and “community” were important factors in addition to the previous findings.

Regarding “surroundings,” residents were concerned regarding the actions of others during rebuilding and deciding where to live. In particular, the word “everyone” strongly co-occurred among residents in their 60s and 70s, who tended to be concerned about the actions of others, their families, and the surrounding environment. Residents constantly faced various choices, such as whether to leave District A, rebuild, or move into public housing for reconstruction, and it was difficult for them to make decisions on their own. They were influenced by changes in the situation and reconstruction projects.

Regarding “community,” new terms such as “neighborhood association” and “festival” (revived from 2016) were extracted in 2017, revealing that the activities of neighborhood association and the community ties that existed before the earthquake became important once again. Furthermore, the word “everyone,” which referred to neighbors, co-occurred among residents of District A and Kamaishi inland in 2012 and among residents of District A and outside Kamaishi in 2017. In addition to residents who continuously resided in District A, residents who left District A were concerned about District A, the “neighborhood association,” and “land ownership.” The elements of "neighborhood association" and "land ownership" may have functioned as a mechanism to receive the feelings of residents who had left the district A for the district.

A limitation of this study is that, to avoid personal identification, it was not possible to link the actual residential structure with the utterances. In addition, the interview survey was suspended due to the global COVID-19 pandemic. Methods to continue the survey are currently being explored.

AUTHOR CONTRIBUTIONS

Conceptualization and methodology: S.A. and N.A.; software and investigation: S.A.; resources and data curation: S.A; writing—original draft preparation: S.A and N.A.; writing—review and editing: S.A.; supervision: N.A. All authors have read and agreed to the published version of the manuscript.

ETHICS DECLARATION

The authors declare that they have no conflicts of interest regarding this study.

ACKNOWLEDGEMENT

We would like to thank the residents of District A and the staff of Kamaishi city hall for their cooperation with our survey. Also, we would like to thank Editage (www.editage.com) for English language editing.

FUNDING

This study was supported by JSPS KAKENHI (grant numbers 19K02139, 22H01657 and 22K14380).

REFERENCES

Araki, S. and Akita, N. (2017). "The Influence on Resident's Residence Selection by Reconstruction Land Readjustment Project in the Tsunami Affected Area -Case Study at District a in Kamaishi City, Iwate Prefecture". *Journal of the City Planning Institute of Japan*, 52(3), 1088-1093. doi: https://doi.org/10.11361/journalcpij.52.1088.

Araki, S., Akita, N., et al. (2019). "Changes in the Recovery Intentions of Residents in Kamaishi City's District a in the Early Stages of Recovery". Paper presented at the Research Report of the 5th Research Exchange Meeting on Earthquake Disaster Problems, Research Network for Earthquake Disaster Issues.

FDMA. (2022). "2011 Tohoku Earthquake (the Great East Japan Earthquake) ". Retrieved from https://www.fdma.go.jp/disaster/higashinihon/items/162.pdf.

Fujimori, T., Koyama, M., et al. (2014). "A Study of Circumstances of Disaster Victims According to Multiple Attributes Using Text Mining Method for Newspaper Articles Related to the 2011 Great East Japan Earthquake". *Journal of Social Safety Science*, (23), 55-64. doi: https://doi.org/10.11314/jisss.23.55.

Goto, S. and Sakai, T. (2017). "Analysis of Transition of Regional Sns Usage at East Japan Great Earthquake and Normal Time". *Journal of International ICT Application Research Society*, 1(1), 144-153. doi: https://doi.org/10.32188/jiiars.1.1_144.

GSI. (2016). "Kamaishi City Urban Planning Land Readjustment Project Wide Area Map".

Higuchi, K. (2016). "A Two-Step Approach to Quantitative Content Analysis: Kh Coder Tutorial Using Anne of Green Gables (Part I)". *Ritsumeikan Social Science Review*, 52(3), 77-91. doi: https://doi.org/10.34382/00003731.

Higuchi, K. (2017). "New Quantitative Text Analytical Method and Kh Coder Software". *Japanese Sociological Review*, 68(3), 334-350. doi: https://doi.org/10.4057/jsr.68.334.

Hyougo-Pref. (2011). "List of Earthquake Reconstruction Land Readjustment Projects". Retrieved from https://web.pref.hyogo.lg.jp/ks23/documents/fukkou.pdf.

Jitsu., K. (2000). "The Great Hanshin-Awaji Earthquake and City Planning". *Bulletin of the Research Institute of Nara University*, 77-91.

Kamaishi-City. (2012). "Status of Damage and Efforts". Retrieved from https://www.city.kamaishi.iwate.jp/docs/2012080300077/file_contents/2012080300077_www_city_kamaishi_iwate_jp_fukko_joho_fukko_machidukuri_fukko_kihonkeikaku_detail___icsFiles_afieldfile_2015_03_23_20110830-120021.pdf.

Kamaishi-City. (2021a). "Basic Resident Register".

Kamaishi-City. (2021b). "Tawamazu Kussezu, Progress in Recovery and Reconstruction". Retrieved from https://www.city.kamaishi.iwate.jp/docs/2019060400109/file_contents/ayumi202103.pdf.

Kamaishi-Unosumai-Memorial-Stadium. "Kamaishi-Unosumai-Memorial-Stadium". Retrieved from https://kamaishi-stadium.jp/%e3%82%b9%e3%83%88%e3%83%bc%e3%83%aa%e3%83%bc.

Meno, F. (2013). "Surveys About Intentions for Housing Reconstruction Conducted by Municipalities of Iwate Prefecture after the Great East Japan Earthquake". Paper presented at the Summaries of Technical Papers of Annual Meeting.

MLIT. (2021). "National Land Numerical Information".

National-Census. (2015). Retrieved from https://www.stat.go.jp/data/kokusei/2015/index.html.

National-Census. (2020).

Nishino, Y., Ishikura, Y., et al. (2013). "Kamaishi City, District a Neighborhood Association Interview Survey Report: Vol.1 *“a” Is the Name of the District.". Retrieved from https://www.stat.go.jp/data/kokusei/2020/index.html.

Sakai, A. and Atsumi, T. (2020). "Process of Psychological Recovery from the Great East Japan Earthquake: The Transition over the 7 Years since the Disaster". *The Japanese Journal of Experimental Social Psychology*, 59, 74-88. doi: https://doi.org/10.2130/jjesp.1824.

Shimoyama, M., Sugawara, A., et al. (2021). "Volunteer Experience of Nursing Students in Health Support Projects That Continued after the Great East Japan Earthquake". *Miyagi University Research Journal*, 1(1), 116-123.

Takeda, K. and Watanabe, Y. (2012). "Factors Related to Low Back Pain, Physical Posture, Psychological Attitude, and Social Attitude in Female Nurses". *Journal of Japan Society of Nursing Research*, 35(2), 113-122. doi: https://doi.org/10.15065/jjsnr.20120425012.

Tsukuda, H., Yamanobe, K., et al. (2017). "A Study on the Change of Housing Recovery Opinions Based on Public Housing Registration Data". *Journal of Architecture and Planning*, 82(731), 1-9. doi: https://doi.org/10.3130/aija.84.311.

Yoshimura, S. (2011). *Japanese and Real Estate-Why Are You Obsessed with Land?*