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Human behavior response to disaster-caused environmental changes: A case of fishing community, San José de Chamanga, affected by the 2016 Ecuador Earthquake

Atsuki Ryokawa[1,*], Akiko Okabe[2]

[1]Graduate School of Frontier Sciences, The University of Tokyo / #632 Environ Bldg, 5-1-5 Kashiwanoha, Kashiwa-shi, Chiba 277-8563, Japan

[2] Graduate School of Frontier Sciences, The University of Tokyo / #632 Environ Bldg, 5-1-5 Kashiwanoha, Kashiwa-shi, Chiba 277-8563, Japan

E-Mail: ratsuki1228@gmail.com (Atsuki Ryokawa)

* Author to whom correspondence should be addressed; Tel.: +81-90-2466-9566

Abstract: In this paper, we focus on the reconstruction processes of both the government and local residents. We define measures outside of the codes of the government as informal measures, as it is important to combine both formal and informal measures to enhance urban resilience. The purpose of this paper is to reveal the strength of resilience displayed— how people have been reshaping their own environment after the disaster and the people's behavior when responding to the process of government-led reconstruction in San José de Chamanga, Ecuador, affected by the 2016 Ecuador Earthquake. Semi-structured interviews were conducted with 74 people for two months, in total, and the major findings were: 1) People's access to waterfront land they had used before the earthquake was endangered because of earthquake damage and the relocation policies that subsequently kept people away: 2) People maintained their access to the waterfront and their fishing habits using their former houses or friends' surviving houses as workplaces and storage, even if they had moved to relocated houses in inland districts. It was concluded that the natural reaction behavior of people and the direction of post-disaster reconstruction policy were incoherent. On the basis of these findings, an alternative reconstruction strategy that takes into consideration the strength of resilience displayed by affected people should be proposed.

Keywords: 2016 Ecuador Earthquake, Post-disaster, Reconstruction policy, Relocation, Informality

1. Introduction

After the Great East Japan Earthquake of 2011, many experts claimed that resident-led disaster prevention and reconstruction was as important as that of the government. In fact, the cooperation of residents played an important role in the survival of this fatal tsunami. For example, some people used traditional evacuation routes that were not officially registered by the government because of their location or condition, but most local people knew how to escape the tsunami quickly. According to Dovey, informality can be defined as the condition outside the formal control of the state[1]. In this paper, we also define such measures outside of states codes as informal measures. When we attempt to enhance "urban resilience," we tend to rely on experts[2] and develop formal urban measures. However, the more the formal measures are highly developed and functioned like in Japan, the less chances we have to exercise informal measures. Hence particularly in highly systematized cities, in case of unprecedented events, the weakness of the informal measures is vital and results low resilience. According to Tisseron[3], the resilience is the ability to respond to damages and it can be attributed to individual or collective "substance," to the "process" through which ability is displayed, or to the reactive "force" as its expression. When the man-made urban fabric of a settlement experiences drastic environmental changes or damaged from a fatal disaster, the affected community responds with its strength of resilience. This is the moment that "the ability of people to shape their own environment"[4] is highly exercised. In this paper, we focus on the power of informal measures and reveal how it was exercised by residents themselves in San José de Chamanga, Ecuador, who were affected by the 2016 Ecuador Earthquake.

2. Site and methods

San José de Chamanga (hereinafter Chamanga) is a fishing village with a population of about 4,500 people,[5] located in the west coastal region of Ecuador. There are approximately 1,000 households, and around 750 households are in the center of Chamanga, the target area of this study. The main economy in this village includes the fishing industry and self-sufficiency agriculture and most economic activities before the earthquake were concentrated on the main street, which is in the waterfront area.

Figure 1. San José de Chamanga

Google Earth

First, research to clarify the actual situation was conducted, such as gathering information from articles mainly on the internet, field surveys, and interviews with local people. Then, to reveal the reaction behavior after the earthquake, semi-structured interviews with 74 local people were conducted during between December 2

[1] Dovey, K (2010) Becoming Places: Urbanism / Architecture / Identity / Power. London: Routledge.
[2] Kurasawa, S. (1977) Toshiteki seikatsu yoshikiron josetsu(Introduction to urban lifestyle theory). In Isomura, E. (ed.) Gendai toshi no shakaigaku(Sociology of modern cities). Kajima shuppankai, pp.19-29. According to him, there are two typical ways to deal with daily tasks and problems. One is that people are more specialized and divided to each professional works and only experts deal with problems. The other one is that not only experts but also residents collaborate with each other and deal with common problems. He defined the former as urban lifestyle and the later as rural lifestyle.
[3] Tisseron, S. (2007) La Résilience « Que sais-je ? ». PUF. (translated into Japanese, 2016)
[4] Illich, Ivan(1973, 2009) Tools for Conviviality. Marion Boyars. London.
[5] According to the government, 4,254 people in 2010. GAD Parroquial Chamanga HP http://chamanga.gob.ec/

and 4, 2016; February 4 and March 4, 2017; and August 30 and September 26, 2017, while participating in reconstruction projects by several universities.

3. The actual situation

The 2016 Ecuador earthquake occurred in the western part of Ecuador at 18:58 on April 16th on local time, and the epicenter was about 20 km from Chamanga. At least 660 people were killed and 17,000 people injured. In Chamanga, it is reported that about 80% of the buildings collapsed.

One month after the earthquake, a temporary refugee camp with about 250 households was built by the government, then the Ministry of Urban Planning and Housing(MIDUVI) supplied prefabricated individual houses (about 70 in the target area). At the same time, a charity organization, Hogar de Crist, also supplied reconstruction houses made of bamboo (25 in the target area). These reconstruction houses were given to people who had their own land in inland districts that the government had approved as safe land. On the other hand, local people have evacuated themselves to the inland districts of Nuevo Jerusalem and Nuevo Milenio, relying on their relatives. The number of households increased from approximately 10 to 70 in Nuevo Jerusalem, and 20 to 150 in Nuevo Milenio. Many of them were living in tents provided by the government for about a year after the earthquake. In May 2017, relocation to a reconstruction residential area named Nueva Ciudadela was started by MIDUVI, and after finishing this relocation, the refugee camp was removed. In Nueva Ciudadela, there are 80 two-story RC buildings, and each building has four rooms of 33 m^2 for families. At the same time, the construction of a fishing port began at the southern end of Chamanga, and the residents in this district were forced to move to Nueva Ciudadela. There are also people who have moved to Nueva Ciudadela from Nuevo Jerusalem, Nuevo Milenio, and other areas.

Table 1. Relocation list

Name	Type	Organization	Period	Number of households
Albergue	refugee camp	government (MIDUVI)	May, 2016～ May,2017	250
Casa de MIDUVI	reconstruction house	government (MIDUVI)	May,2016～	70
Casa de Hogar de Cristo	reconstruction house	NGO	May, 2016～	25
Nueva Ciudadela	relocation district	government (MIDUVI)	May, 2017～	320
San Francisco	relocation district	NGO	Aug, 2017～	50

Figure 2. Nueva Ciudadela

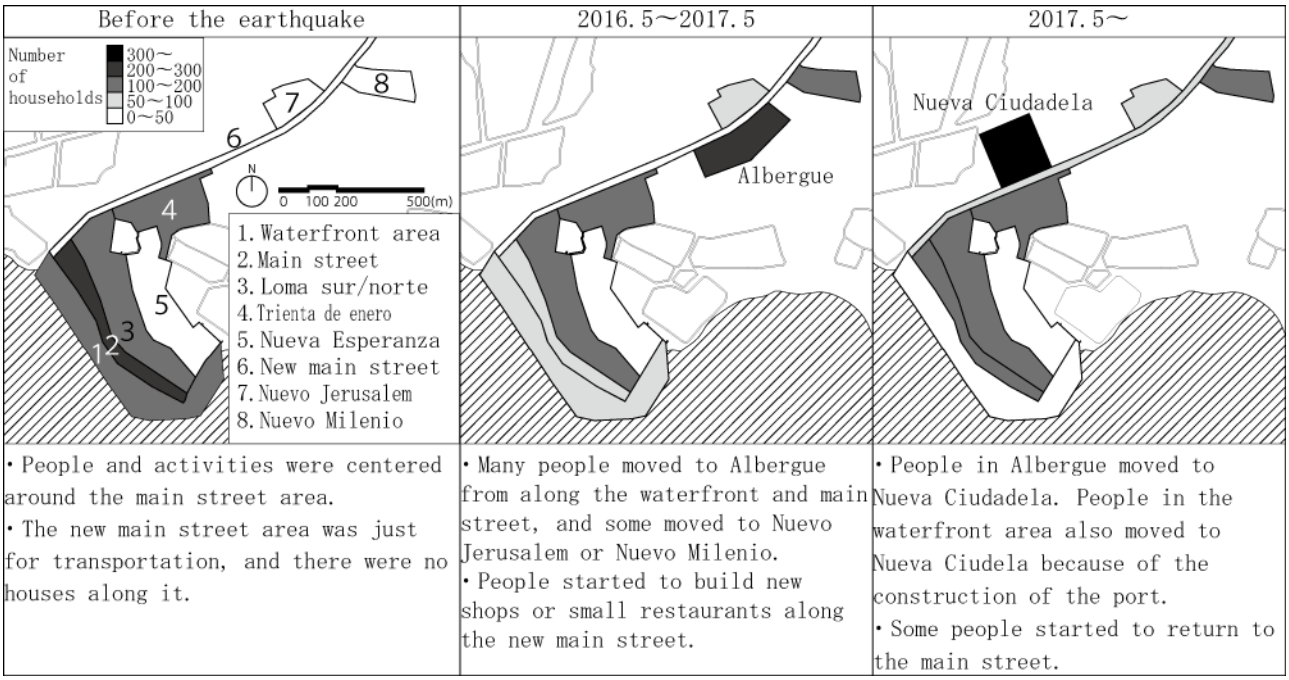
Through these reconstruction processes, the situation of each districts changed remarkably. The major changes were:

1) The population along the former main street and waterfront land declined;

2) The refugee camp and most reconstruction houses were built in the inland districts; thus, the population shifted to the inland area, especially along the new main street;

3) Because of the changes above and the relocation of a bus terminal from the former main street to the new main street, economic activities that had been concentrated on the former main street shifted to the new main street.

Figure 3. Population changes in each neighborhood.



4. Changes in lifestyle

As a result of the interviews with 74 people about their lifestyle, especially the changes in their work, the following lifestyle changes were revealed. (Table 3)

Family composition

In Camanga, it was common to live together with or close to relatives(nos. 5, 24, 48, 50). After the earthquake, however, single households emerged(nos. 19, 24, 31, 40), and some extended families became nuclear families. Because of the security problem, some family members decided to stay in their former houses even if they were damaged, while others moved to the inland districts. On the other hand, there were several cases of nuclear families becoming extended families. (nos. 21, 53, 64). This happened because some people moved to their families' houses to help each other.

Work

It was common that at least one member of a family earned money, especially for the necessities of education and medical treatment, while others fished or farmed to get daily food. In addition, this lifestyle was often shared within an expanded family(nos. 7, 12, 18, 20). A total of 11 out of 34 fisher stopped fishing because they lost their fishery equipment or moved to an inland area(nos. 1, 10, 16, 22). On the other hand, 9 out of 35 people who were running small businesses continued the same or similar jobs after moving to an inland district(nos. 19, 20, 26, 53). A total of 18 people running small businesses had just started their businesses after moving to inland districts to earn money and rebuild their lives.

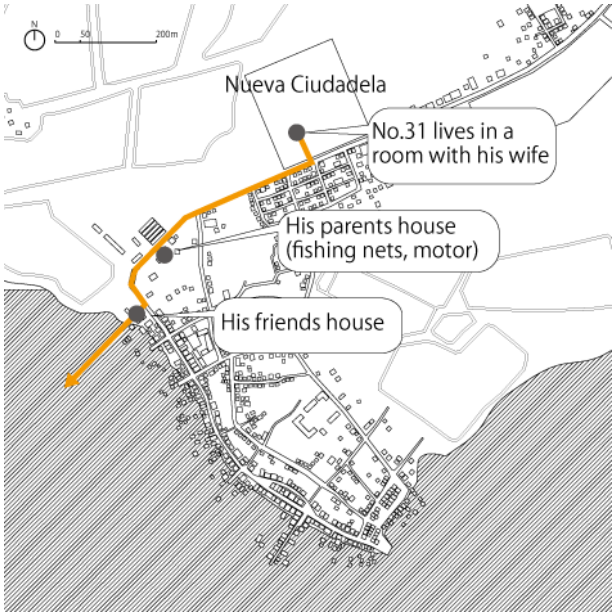
5. Response to environmental changes

The changes described above are results of adaptive actions in the process of environmental changes due to the earthquake and the series of reconstruction policies. To reveal how "the ability of people to shape their own environment" was exercised, this section gives the case of some fishermen as an example.

There are two types of fishermen in Chamanga. One group includes specialized fishermen who go fishing everyday with their own fishing equipment such as boats, boat motors, and fishing nets. Most had lived on waterfront land and lent their fishing equipment to their friends for around 10 US dollars a day. The other includes non-specialized fishermen who normally work at short-term or part time jobs and go fishing when they do not have such jobs. In general, they do not have their own fishing equipment, so they need to borrow it from their friends; this cost can be covered by selling fish they catch. Many men in Chamanga told us that when they do not have a job, they go fishing and borrow the tools from their friends.

Fisherman No.18 is a specialized fisherman, who also sometimes buys/sells fish. When fishermen around his house relocated to inland districts after the earthquake, they asked him to keep their fishing equipment because it was too far to bring with them from their inland houses. Therefore, No.18 fixed and renovated his damaged house and created a space where he and his neighbors could store their fishing equipment. They also fixed the wooden piers to keep their boats and other tools. The case of Fisherman No.31 is another example. When this research was conducted, he did not have a job and was going fishing almost everyday. He had fishing nets and a motor for a boat, but he did not have a boat, so he needed to borrow it every time. There were many fishermen who gave up fishing after relocation, however, No.31 kept fishing after relocation. He was using part of his parents' house as a workplace and storage for fishing equipment and was borrowing a boat from his friend on the waterfront land.

Figure 4. No.31 fishing routes



Most fishermen's waterfront houses were destroyed because of their simple structure; however, some people continued to live on the waterfront to keep their fishing equipment, not only for themselves but also for other fishermen. As a result, once the access to fishing was endangered in the process of the government-led reconstruction, they kept it at the community level by creating a system to keep their fishing equipment on the waterfront.

6. Conclusion

Before the earthquake, in Chamanga, it was common for people to build their houses themselves. When encountering severe environmental changes caused by the earthquake and the reconstruction series, they exercised “the ability of people to shape their own environment” and built/rebuilt/fixed/renovated houses and shacks to keep working. People’s access to waterfront land was once endangered; however, people maintained their access to the waterfront and their fishing habits using their former houses or friends’ surviving houses as workplaces and storage, even if they had moved to relocated houses in inland districts.

When the serious disaster occurred, the government attempts to rebuild and develop the post disaster area with urban planning by experts. In Chamanga, however, the natural reaction behavior of people and the direction of post-disaster reconstruction policies by governments were incoherent. In addition,

the relocation policies can even decrease the urban resilience that needs both formal and informal measures by weakening the ties between neighbors because they seemed not to consider the strength of resilience of local people. On the basis of the findings, for communities where residents have a high ability to solve problems through informal measures, an alternative reconstruction strategy that takes into consideration the strength of resilience displayed by affected people should be proposed. Moreover, these findings suggest that formal measures should be introduced more strategically to enhance informal measures in highly developed urban areas where resilience is believed to be a government's responsibility.

Table 2. Interview results

interviewee			family composition			relocation site			work	
No	sex	age	whole number	number of children	composition	before earthquake	temporary	after earthquake	before earthquake	after earthquake
1	m	26	4	2	nuclear	waterfront		loma sur	fisher, barber	barber
2	f	50s	?			main street		same	chicken comedor	-
3	m	50s	?		extended →nuclear	loma		same	fisher	fisher
4	f	20s	2		nuclear	loma		casa de miduvi	-	-
5	f	50s	2	1	nuclear	trienta de enero		casa de miduvi	-	-
6	m	52	8	6	extended	waterfront	refugee camp	Nueva Ciudadela	fisher	fisher
7	f	50s	2		nuclear	former main street	refugee camp	Nueva Ciudadela	-	selling snacks
8	m	40s	8	6	extended	waterfront		Nueva Ciudadela	fisher	fisher
9	m	50s	?			new main street		same	unknown	working in Pedernales
10	m	24	2		nuclear	waterfront	refugee camp	Nueva Ciudadela	fisher, barber	barber
11	m	24	?			waterfront	refugee camp	Nueva Ciudadela	fisher	fisher
12	f	57	4	2	nuclear	field		Nuevao Milenio	comedor	-
13	m	20	?		extended →nuclear	waterfront		Nueva Ciudadela	fisher	guard
14	m	16	10	8	nuclear	loma	refugee camp	Nueva Ciudadela	-	-
15	m	50s	1		nuclear →extended	waterfront	refugee camp	Nueva Ciudadela	hostel owner	drink shop
16	m	19	2		extended →nuclear	waterfront		San Francisco	fisher	-
17	m	29	3	1	extended →nuclear	waterfront		Nueva Ciudadela	teacher	teacher
18	m	40	8	?	extended	waterfront		same	fisher / fish dealer	fisher / fish dealer
19	m	40s	1		nuclear →extended	loma	refugee camp	Nuevao Jerusalem	barber	barber
20	f	33	?		extended	trienta de enero	refugee camp	trienta de enero	storekeeper	storekeeper
21	m	32	7	4	nuclear →extended	other		trienta de enero	Pedernales	fisher
22	m	25	1		single	trienta de enero		trienta de enero	fisher	construction
23	f	37	4	3	nuclear	trienta de enero		same	store	store
24	f	57	1		extended →nuclear	trienta de enero		casa de miduvi	store	store
25	m	57	6	?		waterfront	refugee camp	Nueva Ciudadela	teacher	cyber
26	m	63	8	3	extended	mainstreet		new main street	storekeeper	storekeeper
27	f	37	4	2	nuclear	new main street		same	hostel owner	cyber
28	m	24	1			new main street	field	new main street	part-time	barber
29	m	19	6	4	nuclear	mainstreet		new main street	-	barber
30	m	20	2	1	nuclear	mainstreet	refugee camp	Nueva Ciudadela	-	-
31	m	26	2		extended →nuclear	new main street	refugee camp	Nueva Ciudadela	fisher, part-time	fisher, construction industory
32	f	33	6	1	extended	new main street		same	Decameron	-
33	f	17	6	4	nuclear	new main street		same		-
34	m	32	4	2	nuclear	mainstreet	field	Nueva Ciudadela	cyber/agriculture	cyber/agriculture
35	m	19	3	1	nuclear	waterfront	refugee camp	Nueva Ciudadela	fishing	fishing
36	m	62	?		extended	loma		same	fishing	fishing
37	m	63	2		nuclear	mainstreet		same	fishing	fishing
38	m	45	?			mainstreet		same	fishing	fishing

interviewee			family composition			the site of relocation			work	
No	sex	age	whole number	number of children	composition	before earthquake	temporary	after earthquake	before earthquake	after earthquake
39	f	32	7	2	extended	mainstreet		same	ice-cream seller	ice-cream seller
40	m	62	1		extended →single	loma	refugee camp	casa de hogar de cristo	-	raising chicken
41	m	16	4	2	nuclear	waterfront		same	student	student (sales on street)
42	m	28	4	2	nuclear	waterfront		Nuevao Milenio	Decameron(Hotel)	fishing, construction
43	m	28	1		single	other		trienta de enero	counselor	“cyber”
44	m	21	7	2	extended	mainstreet	refugee camp	same	fishing	fishing
45	m	14	5	3	nuclear	waterfront	refugee camp	same	student (fishing)	student (fishing)
46	m	24	12	8	extended	waterfront		same	fishing	fishing
47	f	33	5	3	nuclear	waterfront		same	store	store
48	f	34	4	3	nuclear	mainstreet		same	store	store
49	f	18	7	2	extended →nuclear	mainstreet	refugee camp	field	-	-
50	m	56	3	1	nuclear	loma		same	fishing	fishing
51	m	55	5	1	extended	loma		same	fishing	fishing
52	m	21	3	2	nuclear	loma		same	volunteer management group	volunteer management group
53	f	39	6		nuclear →extended	mainstreet		new main street	store	store
54	f	9	5	3	nuclear	Nuevao Milenio		casa de miduvi	student	student (street vendor)
55	m	24	4	2	extended →nuclear	loma		Nuevao Milenio	fishing/comedor	fishing/comedor
56	m	17	6	4	nuclear	mainstreet	refugee camp	Nueva Ciudadela	fishing	fishing
57	m	20	4	1	nuclear	waterfront		Nueva Ciudadela	-	-
58	m	25	?			?		Nuevao Milenio	?	fluit vender
59	f	34	5	3	nuclear	loma		Nueva Ciudadela	-	-
60	f	35	5	3	nuclear	other		San Francisco	-	-
61	f	21	4	2	nuclear	waterfront	Nuevao Jerusalem	San Francisco	-	-
62	f	69	3	1	extended →nuclear	Nuevao Milenio		same	-	ice-cream seller
63	m	50s	?			mainstreet		new main street	ferreteria owner	ferreteria owner
64	m	37	7	3	nuclear →extended	waterfront		casa de miduvi	Decameron	ferreteria
65	m	21	2		extended →nuclear	mainstreet	refugee camp	Nueva Ciudadela	fishing	fishing
66	f	37	6	4	nuclear	Nuevao Jerusalem		same	teacher	teacher
67	m	50	8	?	extended	waterfront		field	fishing	construction
68	m	68	5			mainstreet		field	agriulture	agriculture
69	f	30	5	3	nuclear	Nuevao Milenio		same	Decameron	-
70	m	40s	?			field		same	construction	construction
71	m	20s	4	2	extended →nuclear	loma	refugee camp	Nueva Ciudadela	construction	construction
72	f	25	6	4	nuclear	waterfront	Nuevao Jerusalem	Nueva Ciudadela	small comedor	-
73	m	40s	?			mainstreet		Nueva Ciudadela	store	store
74	f	40s	4	2	nuclear	waterfront	loma	same	?	?

Conflict of Interest

The authors declare no conflict of interest.

No references for the short papers but hyperlinks within the text