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Geographical Housing Recovery Process after Mega-Earthquake-Disaster, 1995 Kobe and 2011 Tohoku

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Abstract

The task of building the recovery system for areas damaged in disaster is common in various countries around the world. In the case of mega disasters, it is necessary to provide public support system for rebuilding housing because of the lack of stocks for victims. Although housing recovery case studies after disasters around the world have already been reported, there are few comparative studies from the viewpoint of provision method and geographical layout characteristics. This article shows the housing recovery differences in the public policy and the geographical layout at each stage of urban reconstruction process.

To clarify, firstly I examined a current principle of housing recovery system after disaster based on UN reports and professional documents. Second, Japan recently disaster cases (Kobe 1995, Tohoku 2011) were picked up and I analyzed the public housing provision characteristics from a viewpoint of housing sites layout, which affected urban recovery process and housing recovery support. In order to examine them, I collected data such as research papers, governmental report documents and national census data. It pointed out the close relationship between housing recovery process and population growth. Additionally, housing location sites depended on the space layout in the area and urban growth stream before disaster. Third, I tried to draw three points of consideration when Japan faces the Nankai megathrust Earthquake. Japanese housing recovery system has week points of self-build support, the linking to urban recovery plan and the objective and methods toward urban reconstruction, I suggest the necessity of the creation of the new methodology for housing recovery system. The result indicates the importance of the land management at the time of pre-disaster and post disaster. These perspectives are so important to plan for next disaster that we need to accumulate lessons learned from experiences.

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Keywords: Kobe Earthquake, Tohoku Earthquake, housing recovery, geographical location of housing, Mega-Disaster, disaster recovery

1. Introduction

There have been many studies on housing recovery processes after large-scale natural disasters. However, housing damage caused by the 2011 Great East Japan Earthquake confronted this discipline with a new set of problems. These include theories around the enormous provisions of new-housing required for wide areas, structural measures for tsunami defences, relocation to avoid tsunami risks, job losses in acutely affected areas, adaptation to job changes in new environments, and long-term temporary housing in the wake of nuclear disasters. However, considering both domestic and international case studies, each individual concern is not new. The underlying problem is the lack of an approach to plan a comprehensive recovery of the areas where these issues arose, and the underdevelopment of concrete solutions to these individual problems.

In modern society, it is clear that the housing reconstruction process is a primary factor in rebuilding survivors' lives that leads to the regeneration of regional communities. However, we have not succeeded in forming theories for post-disaster housing planning and housing supply, which are the primary elements greatly affecting the overall social system within communities. Prompted by the Great East Japan Earthquake, the discussion of 'recovery and reconstruction' in the reformed disaster management plan has been described as well-rounded but has not sufficiently clarified the content of these plans, and there are calls for the theorisation of planning around this. In the context of rising social uncertainties, the predictions for an earthquake that would directly affect the Tokyo area, and a Nankai megathrust earthquake in the near future, methodological research needs to be conducted in formulating specific and effective housing reconstruction plans.

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2. Methodology of Housing Recovery Support by Public Sectors

After the disaster, shelters and new dwellings must be built for those who lost their housing. Various of sectors have a role to provide them, and the methodology have been discussed by specialists and researchers. Davis and Alexander (2015) shows the models of housing recovery process using the comparison of several disaster cases. Davis (1982) described the guideline about providing and managing shelters after disaster. There are many experiences of recovery housing process in the world.

Those who lost their house by the disaster generally had the stage of temporary housing before the acquisition of their permanent house. The methods of providing temporary housing stock are mainly to build sheltering spaces and to use vacant room stock such as hotels, public housing and so on.

Table 1 shows main methods of public and government sectors for re-build new housing. Everywhere, public sectors responsibilities are common as "Support for victims who are disable to build or get permanent housing after disaster".

Table 1. Public/Government housing provision support methods

Public/Government Sector	How do victims get new housing?
Cash support	Acquiring on their own form a housing-market or Build by themselves or NPO/NGO support
Cash support + Provision housing	Acquiring from a limiting housing market for only victims
Provision public housing	An apartment for rent, Public housing system
Development New town by government	Relocation of a whole damaged town

3. Analysis of Public housing provision

The process of moving from temporary to permanent housing can be explained through the new provision of housing stocks and the utilisation of existing resources. Within the overall process of disaster recovery, this study will focus on prefabricated temporary housing and public lease housing, as these direct and new provisions in disaster-affected regions lead to problems with population distribution, and therefore, impact the entirety of an urban area. We will investigate the relationship between the spatial arrangement at the time of provision and the post-recovery urban design by considering the provision that took place after the Kobe and Great East Japan Earthquakes. The housing recovery process in Fukushima Prefecture will only be used for reference in the analysis, as this is a unique case due to its proximity to the nuclear plant accident.

3.1 Prefabricated Temporary Housing Site Locations

Table 2 shows the provision of temporary housing in the Iwate and Miyagi Prefectures by the local authorities. As the amount and location of construction are determined by the local authorities themselves, some discrepancies are evident in the provisions. These differences also arise due to priority being determined as based on the number of disaster-affected homes, the particular characteristics of tsunami-inundated areas, and the locations where building temporary housing is possible.

Table. 2 Number of temporary housing by the local authorities in the Iwate and Miyagi Prefecture

	Pre-disaster	Tsunami Area	Damaged Housings			Public Temporary Housing			
	Number of Householders	Number of dwellings	Collapsed	Part-Collapsed	Collapsed/ Householders	Prefabricated	Private rental	Total	Temp./ Collapsed
IWATE									
Miyako	24,332	7,209	2,767	1,331	11%	2,010	684	2,694	97%
Ofunato	14,729	6,957	2,789	1,148	19%	1,811	718	2,529	91%
Rikuzen-Takata	8,196	5,592	3,805	236	46%	2,168	175	2,343	62%
Kamaichi	17,561	5,235	2,957	698	17%	3,164	693	3,857	130%
Otsuchi	6,348	4,614	3,092	625	49%	2,146	135	2,281	74%
Yamada	7,182	4,175	2,762	405	38%	1,990	312	2,302	83%
Others	427,700	5,891	935	2,163	0.2%	695	1,744	2,439	261%
IWATE Total	506,048	39,673	19,107	6,606	3.8%	13,984	4,461	18,445	97%
MIYAGI									
Sendai	455,958	10,385	30,034	109,609	7%	1,523	8,580	10,103	34%
Ishinomaki	60,928	42,157	20,036	13,045	33%	7,297	6,568	13,865	69%
Shiogama	22,165	6,973	672	3,278	3%	206	399	605	90%
Kesennuma	26,601	13,974	8,483	2,571	32%	3,504	1,678	5,182	61%
Natori	26,433	3,974	2,801	1,129	11%	910	1,283	2,193	78%
Tagajo	24,733	6,648	1,746	3,730	7%	373	1,407	1,780	102%
Iwanuma	16,003	2,337	736	1,606	5%	384	452	836	114%
Higashi-Matsushima	15,080	11,251	5,515	5,559	37%	1,753	1,299	3,052	55%
Watari	11,442	4,196	2,389	1,150	21%	1,126	697	1,823	76%
Yamamoto	5,561	2,913	2,217	1,085	40%	1,030	760	1,790	81%
Shichigahama	6,568	2,751	674	649	10%	421	224	645	96%
Onagawa	3,852	3,155	2,924	349	76%	1,294	451	1,745	60%
Minami-Sanriku	5,362	4,375	3,143	178	59%	2,195	326	2,521	80%
Others	234,507	1,669	1,623	11,188	0.7%	79	1,926	2,005	124%
MIYAGI Total	915,193	116,758	82,993	155,126	9.1%	22,095	26,050	48,145	58%

Reference 4)

Table 3 illustrates the pre-disaster land use patterns of the areas in which prefabricated housing sites were built after the Great East Japan and Kobe Earthquakes. The total number of sites in GEJE was 912 in mainly three damaged prefectures, while Hyogo in Kobe Earthquake had 634 sites.

The acquisition of land is a determining factor in the location and size of temporary housing sites. Temporary housing is public housing, and is primarily built on publicly owned land. In general, public development land and park sites are allocated for this. However, there were insufficient public sites in the areas affected by the Great East Japan Earthquake, and some local authorities had to provide large numbers of dwellings from privately owned land. Meanwhile, a total of 38 large-sized housing sites (200 dwellings and above), public and private industrial parks, and development sites for housing, sporting fields, and other former commercial sites were used (Table 4). These areas were usually located far from the urban area.

Table 3 Type of pre-land use for prefabricated housing

SITES (N=912)	Partk, Sports Field	School Ground (incl. abolition)	Development Space	Private Property	Total	Public use Rate
IWATE	54	50	43	170	317	46%
MIYAGI	112	60	63	171	406	58%
FUKUSHIMA	37	5	81	66	189	65%
UNITS (N=52621)						
IWATE	2,571	3,226	1,535	6,652	13,984	52%
MIYAGI	6,924	3,415	5,116	6,717	22,172	70%
FUKUSHIMA	3,002	169	7,225	6,069	16,465	63%
AVERAGE						
IWATE	48	65	36	39	44	
MIYAGI	62	57	81	39	55	
FUKUSHIMA	81	34	89	92	87	
KOBE Earthquake						
HYOGO sites	283	18	249	84	634	
units	17,310	1,501	24,571	4,918	48,300	90%
average	61	83	99	59	76	

Table 4 Scale of temporary housing Sites

	GEJE		KOBE	
Scale	sites		sites	
20−	307	34%	20	3%
20−100	456	50%	482	76%
100−200	111	12%	68	11%
200−	38	4%	64	10%
	912		634	

Although this volume of provisions is similar to that of the urban-based 1995 Kobe Earthquake, the Great East Japan Earthquake, in comparison, (1) had a larger overall supply area, with temporary housing more widely located; (2) saw the building of fewer large-sized housing sites and more small-sized housing sites; and (3) used more privately owned land.

Next, in order to identify trends in the location of prefabricated temporary housing sites within areas under local authorities, we used Geographic Information System (GIS) mapping to combine former public facility locations with tsunami-inundated areas, prefabricated temporary housing construction locations and size, and major road networks. This analysis highlighted the following features of the provisions:

- ✓ The location of mid- and large-sized temporary housing along main roads in a line from the seaside towards the inland areas (most local authorities).
- ✓ The location of mid- and large-sized temporary housing alongside tsunami-inundated areas (implementation of urban planning projects and other surface preparations; designation of areas in danger of being affected by disasters).
- ✓ The location of small-sized temporary housing sites scattered around the peninsula (small fishing communities affected by disasters).
- ✓ The location of large-sized temporary housing sites in a line along inland major arterial roads (south of Higashi-Matsushima and Sendai).

Regions designated as being in danger of disasters and that have implemented large-scale urban planning projects have many large- and small-sized temporary housing sites scattered across inland areas. Large-scale urban planning projects require between five and ten years. Compared with urban earthquakes, tsunami disasters are more likely to incur damages that decimate entire areas, resulting in a relatively long time period before the functional recovery of communities is possible. As this affects housing reconstruction, it also influences the location of the temporary housing.

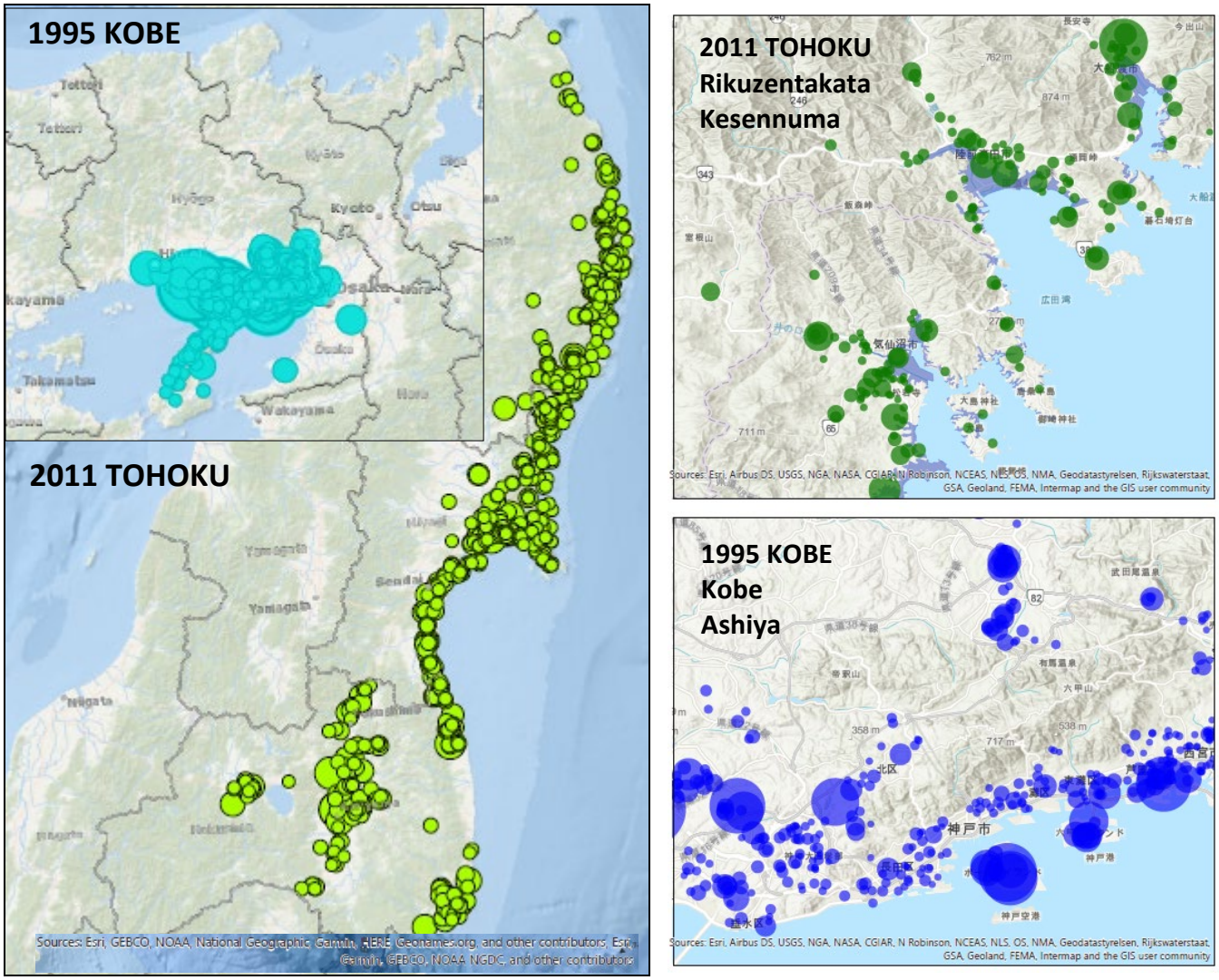

Figure 1 Site locations of temporary housing (Comparison at the Same Scale)

3.2 Proportion of prefabricated temporary housing provisions

The number of prefabricated temporary housing sites after the Great East Japan Earthquake across the two prefectures was lower than that in the sole prefecture affected by the Kobe Earthquake in terms of provision volume and provision rate. This is partly due to the post-disaster public-funded rental accommodation scheme that was institutionalised and utilised after the Great East Japan Earthquake. This scheme reduced the number of prefabricated temporary housing sites and played a role in the early provision of housing. Meanwhile, it has been pointed out that the use of the private rental housing market has given rise to issues such as an increased difficultly in monitoring disaster victims, the fragmentation of former communities, and the separation from former areas of residence. As much of the post-disaster public-funded rental accommodation scheme is located in urban areas, this type of housing provision encourages the urban relocation of disaster-affected individuals.

3.3 Continuity of disaster recovery public housing

Figure 2 illustrates the location of disaster recovery public housing and shows that the volumes are small compared to that of the prefabricated temporary housing, and that the provisions are scattered across the inland non-damaged local governments. This is in contrast with the case of the Kobe Earthquake, where the disaster recovery public housing spread across the affected region and acted as alternative housing for people on a low-income salary. The role of public housing in TOHOKU was smaller from the viewpoint of the low-income housing recovery assist.

The targets for the disaster recovery public housing (DRPH) are those affected by the disaster who would struggle to rebuild their homes by themselves. In contrast with the Kobe Earthquake, whose effects were concentrated on the elderly and people with a low-income, the housing damage from the Great East Japan Earthquake was incurred across the region, partly due to the height of the tsunami. There were not necessarily any disparities in the resultant damage regarding the social classes affected. The low number of targets for the disaster recovery public housing is a unique characteristic of this disaster.

The disaster recovery public housing functions as housing reconstruction support for disaster victims, as well as for regional recovery. The latter is strongly related to urban recovery planning, and in the case of the Great East Japan Earthquake (similar to temporary housing sites), there are difficulties in securing locations for construction. In addition to safety and accessibility, ease of land acquisition is a key requirement, and it proves difficult to construct disaster recovery public housing in places and times that reflect the recovery process of the disaster-affected regions.

Table 5 Comparison among Public Housing Recovery

		Temporary		Public Housing
	Needs Recovery	Prefab.	Rental	DRPH
IWATE	20,000	14,000	5,000	6,000
		70%	25%	30%
MIYAGI	90,000	22,000	26,000	16,000
		24%	29%	18%
HYOGO	130,000	48,000	–	42,000
		37%		32%

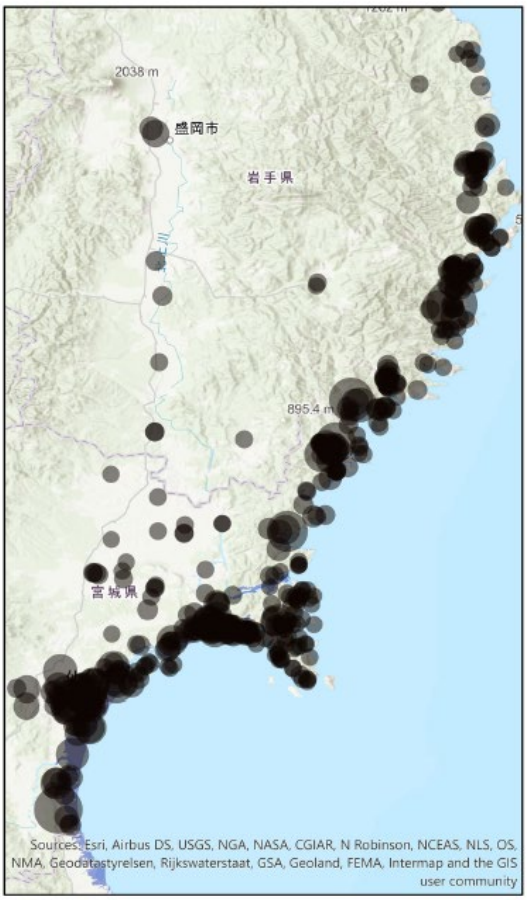

Figure 2 DRPH locations in Tohoku

3.4 The effects of temporary housing on housing recovery

According to the basic policy for housing recovery in Iwate Prefecture, the provision plan includes approximately 14,000 emergency temporary dwellings, 5,000 post-disaster public-funded rental accommodation dwellings, and 5,000 public houses for permanent residents. The plan also includes approximately 13,000 other dwellings, including self-reconstruction and reconstruction using rental accommodation. Among these unaided reconstructed dwellings, around 8,200 sites will be provided from surface-prepared areas. Therefore, the proportion of housing reconstructions that use public provisions and publicly prepared sites is extremely high at 97% for temporary housing, and 74% for permanent housing.

In the case of Miyagi Prefecture, its housing recovery plan aims to recover approximately 72,000 dwellings and includes providing 15,500 public housing dwellings. In terms of temporary housing, the prefecture will build 22,095 emergency temporary dwellings, and 25,050 households will utilise the post-disaster public funded rental accommodation. In terms of permanent housing, analysis of resettlement support-funded grants reveals that approximately 90,000 households require housing reconstruction to date, and in August 2014, 23,600 households had constructed or purchased housing, whilst 12,114 had moved into rental accommodation. Of the remaining housing required, approximately 15,000 dwellings are to be provided through public housing, and 39,000 are predicted to undergo unassisted reconstruction. Furthermore, surface preparation projects for approximately 11,000 dwellings are required on sites for private and other housing types. As such, it is calculated that public housing will make up approximately 58% of the temporary housing total and 32% of the permanent housing total—an overall public disaster housing rate of around 20%. Overall, this is a lower proportion of public provisions than that in Iwate Prefecture.

The difference between the two Prefectures lies in the housing provision ability, which stems from the existence of built-up areas adjacent to the tsunami-affected regions, as well as from the availability of the private housing market and rental accommodation characteristics in urban areas. In Iwate Prefecture, many of the worst-affected areas under local authorities encompassed city centre areas, and there were no continuities within the surrounding built-up areas; thus, the recovery plan focused on public support. Meanwhile, in Miyagi Prefecture, the day-to-day functional recovery of the slightly more inland and less urban regions, that were not the worst affected, seems to have advanced from an early stage, and has been absorbed by those who were able to rebuild on their own, resulting in a lower proportion of public support provided.

Compared with the housing recovery situation in Kobe Prefecture after the Kobe Earthquake (see Table 5), we can identify a low level of public housing provisions. As the Kobe Earthquake was an urban-based disaster, many new accommodations were provided, and the housing market quickly reached maximum capacity. However, this was not sufficient to house all of the disaster victims and resulted in a high proportion of the public housing being used. Although some have said that there is a larger number of households with a high capacity of reconstructing their own housing this time, we have seen the limits of this as time has passed. It is possible that we need to reconsider the proportion of the public provisions in housing reconstruction by referring to the slow recovery rates of economic activity and employment.

Figure 3 shows the relationship between the population recovery rate (2010-2015) and the public housing assist rate (Temporary housing rate, Prefabricated housing rate, DRPH rate) at the local authorities. Local government's population had recovered and located around the centre city of Tohoku, Sendai. They almost had the high rate of temporary housing for damaged housing number. This figure shows that population recovery seems to depend on the rate of temporary housing for damaged housing. On the other hand, municipalities that had not recovered, had severe damage and spent a lot of time to rebuild new facilities for town life. DRPH had no role in new type housing for those who wanted to live there again. These facts indicate that there is a gap in the problem between building houses and recovering life in the post disaster process.

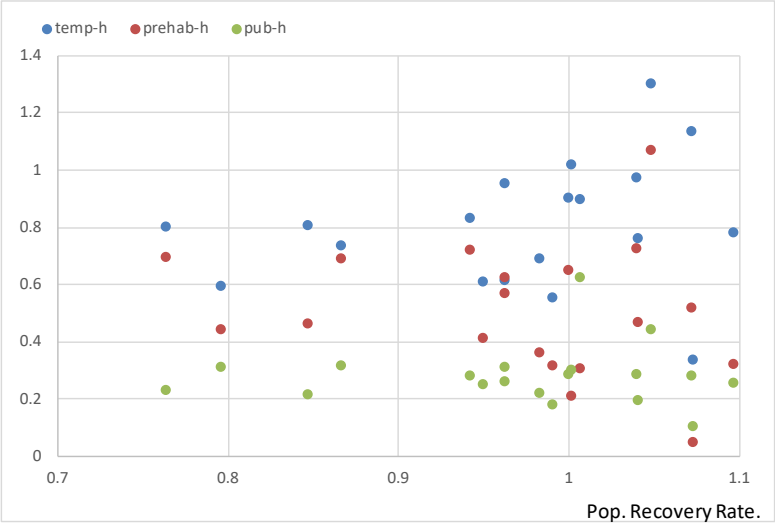

Figure 3 Population recovery rate and public housing assist rate

4. Consideration for Mega-Disasters in Japan

Japan has experienced the large-scale housing loss by the earthquake disasters. That indicated that post disaster management including housing recovery and urban planning was the most important issue for not only development country with vulnerable conditions but also advanced country with a different vulnerability. This shows Japan housing recovery problems discussing in the field of the housing recovery as follows.

・Diversification of support measures for those facing difficulties in the self-rebuilding process

In the Japanese system, the provision of public housing is the only support measure available for those facing difficulties in independently rebuilding their homes following a disaster. Upon close examination, this is a unique measure from a global perspective. This measure encapsulates issues based on findings of previous articles that have discussed the regular housing policy, the maturity of the private housing market, and the importance of diversifying the process through which the lives of disaster victims are reconstructed. The government must work towards increasing policy options that consider large-scale disasters that may occur in the future.

・The link between regional recovery and housing reconstruction is weak

Considering cases of disaster recovery in the world, the framework of the housing provision system during a disaster often revolves around supporting the reconstruction and recovery of local communities. In many cases, housing reconstruction clearly plays an essential role in rebuilding the lives of disaster victims and restoring affected areas to their former state. In addition, the relationship between housing reconstruction, community maintenance, commerce, the economy, and employment is linked with the support measures provided for those facing difficulties in the self-rebuilding process and the construction and provision of housing for disaster recovery. Compared to many cases in the world in which disaster victims directly participate in the regional planning and the process of housing reconstruction, Japanese support measures for those facing difficulties in the self-rebuilding process during disaster recovery is thought to prevent disaster victims from participating in the planning, which in turn restricts the recovery process.

· Deviation from urban safety planning

In areas where there is insufficient development in urban infrastructure due to disaster prevention efforts, housing reconstruction measures supporting disaster victims are only one part of the disaster recovery plan. It is necessary to determine the position of the housing reconstruction plan within the urban planning strategies geared towards disaster response and control. However, due to the excessive emphasis placed on the urgency of housing provision in Japanese cases of disaster recovery, the role played by housing stock as an element of a given city in the decades to come is not sufficiently discussed. Furthermore, the activities and operations involved in the urban reconstruction process in Japan proceed without adequate discussions on the future image of the city. Regarding this issue, it has been indicated that the recovery plan must be linked with both the basic and master plans. As such, it is therefore necessary for all members of society to share and recognize the importance of planning for the construction of a safe city, and for those executing the plan to strike a balance between housing reconstruction and the reconstruction of people's lives. Accordingly, it is also necessary to develop planning skills to manage the recovery process of society as a whole.

5. Discussion

5.1 Quantity and location of urban space, and the constraints they impose on response and recovery

The loss of vast quantities of housing to natural disasters destroyed individual homes, neighbouring relations, and community activities. Rebuilding requires large amounts of time and money, and the loss in terms of direct damage and the rebuilding time could be huge.

It is clear that the process of rebuilding housing for disaster-affected victims is greatly affected by the space that public bodies have available to them at the time of the disaster, as well as by the management approach taken. However, from the perspective of those responding to disasters, acquiring land after natural disasters involves processes of selection, coordination, and negotiation, which are all heavy burdens for local authorities. In many cases, the speed with which land can be prepared determines how fast temporary housing can be provided. If any stage of the processes relating to temporary housing is delayed, the resettlement of the individuals is also delayed, and this is at the root of many of the difficulties faced in regional reconstruction. However, if speed is over-prioritized, then the individual problems of the disaster victims would emerge. These problems need to be understood, and disaster management plans need to be created in advance.

5.2 Recovery spaces determined by policy

The crucial difference between post-disaster urban recovery and everyday regional planning is the speed in which it is required. The disaster victims are the main characters acting in post-disaster regional planning, and these victims do not only cooperate in the construction of community spaces but must also rebuild their lives through resettlement. The reconstruction of regional human resources also needs to be carried out swiftly to raise the social capital of residents and prioritize the creation of environments, to which individuals can be highly adaptable. It is no secret that incorporating the consent of disaster victims into urban recovery planning and physical disaster prevention measures necessitates time and effort, as does developing new strategies to resolve individual problems that arise from the natural disasters.

Therefore, post-recovery spaces tend to be designated based on available methods such as those in the pre-disaster-determined everyday policies and plans. For small-scale natural disasters, detailed planning can be carried out between residents and authorities. However, in large-scale disasters, manpower, time, materials, and financial resources are in short supply, meaning that methods and conditions for resolving individual issues cannot be simply developed. This is the most formidable problem that large-scale disasters entail.

6. Acknowledgements

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