

Long Term Recovery from the 3.11 East Japan Earthquake Disaster: Evaluating Resettlement Projects after Tsunami Disasters

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SUMMARY:

This paper reports damage at the resettlement site from Meiji (1896) and Syowa (1933) Sanriku Tsunami disaster from historical documents review and field survey of those resettlements after the East Japan Earthquake Disaster. From the analysis of data, four types of damage pattern in those resettlements sites were clarified. 1) No damage: Aneyosi, where is famous for a stone monument saying that villagers should not live under the monument, did not get any damage in spite of the highest tsunami inundation of this event. 2) Slight damage: Resettlement site of Meiji tsunami have stayed in higher ground and did not suffer from major damage. 3) Major damage in expanded lowland settlements: Syowa Resettlement community have expanded their settlement to lower land and got damage. 4) Major damage in resettlement site: Some Syowa resettlement site got damage for unexpected scale of Tsunami.

Keywords: The East Japan Earthquake Disaster, Tsunami, Recovery, Resettlements

1. INTRODUCTION

The East Japan Earthquake Disaster on March 11, 2011 (EJED) resulted in 18,916 deaths and missing, and 129,472 severe damage, and 255,977 minor damage buildings, which occurred especially in Iwate, Miyagi, and Fukushima Prefecture (Level 1 Disaster Response Headquarter, 2012). Those damages were mainly caused by tsunami. After the event, national government set two category of tsunami hazard such as level 1 tsunami, and level 2 tsunami for tsunami disaster reduction. Level 1 tsunami is 100 year interval tsunami, and strategy for level 1 is “prevent damage”, and constructs sea wall to prevent damage from this height of tsunami. Level 2 tsunami is 1,000 year interval tsunami, and strategy for this tsunami is “mitigate damage”. Comprehensive disaster reduction including land use regulation, tsunami warning will be compiled to save human lives from level 2 tsunami. Recovery project from the East Japan Earthquake Disaster was planned considering those two levels of tsunami. Resettlement to higher ground or mound making in lower land is now planned in impacted area. Figure 1 shows the concept of land use plan for recovery projects.

Impacted area of the EJED was hit by tsunami every 30-50 year such as the 1896 Meiji Tsunami Disaster, the 1933 Syowa Tsunami Disaster, and the 1960 Chili Tsunami Disaster. Every after tsunami disaster, impacted area moved to a resettlement site in higher ground. However, people moved back to lowland near from the sea because of population growth and inconvenience to fishing business, and hit by another tsunami. It is important to monitor the history of resettlement site after Meiji and Syowa resettlement site, and the damage at those resettlements. This paper reports damage at the resettlement site from Meiji (1896) and Syowa (1933) Tsunami Disaster from historical documents review and field survey of those resettlements after the EJED.

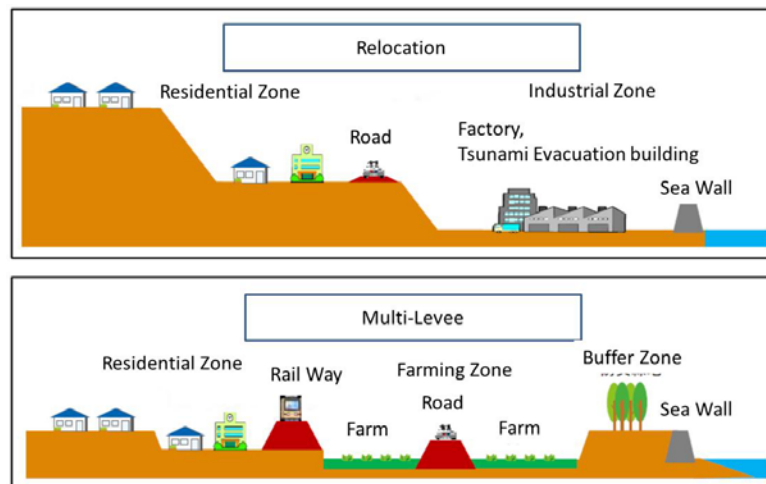


Figure 1. Concept of Land Use (Source: Miyagi Prefecture Recovery Plan)

2. RESTTLEMENT AFTER THE 1933 SYOWA TSUNAMI DISASTER

2.1. Recovery Plan from the 1933 Syowa Tsunami Disaster

The 1933 Syowa Tsunami Disaster killed 4,007 people, and destroyed 4,453 buildings in Miyagi and 4,932 housing units in Iwate. For the recovery of this disaster, national government established recovery plan consist of resettlements at 102 villages in Miyagi and Iwate Prefecture. Department of Urban Planning, Ministry of Interior published the report about recovery (Department of Urban Planning, Ministry of Interior, 1934). There were two types of recovery plan, one is for urban area, and the other for fishery and farming village. Recovery plan for urban area are consists of 1) location, 2) road network, and 3) tsunami protection, and that for fishery and farming village are 1) location, 2) resettlement site, 3) road network, and 4) tsunami protection. Table 1 shows contents of the recovery plan.

Contents of the plan are very similar to that of the EJED recovery plan. One difference is about sea wall. Though a big sea wall will be constructed to prevent level 1 tsunami for the EJED recovery, tools to disaster reduction was resettlement to higher ground in Syowa recovery. Figure 2 show the examples of drawing for resettlement site.

2.1. Implementation of Recovery Plan

Municipality governments were implementation body of the recovery plan. Two major projects were 1) road recovery projects and 2) construction of resettlement sites. Total cost of projects amounted to JPY 675,879, which is 49 % of the annual budget of all the corresponding municipality governments. And national government supported the municipality governments as follows: 1) 85% of road recovery project costs will be covered by the national government, 2) Low interest loan for the resettlement site construction projects was established, and interests of loan were paid by the national government.

Private land was acquired for resettlement sites, and some municipality government and community owned land were used for resettlement sites. And residents in resettlement sites get their land by paying the money for 15 years (the first five years are moratorium). The price of resettlement site lot is calculated as follows: (Cost of land actuation + Construction cost of resettlement) / Portion of occupying land. Sixty villages (11 community resettlements, 49 individual resettlements) in Miyagi and thirty eight villages (all the 38 community resettlements) in Iwate conducted resettlement after the 1939 Syowa Tsunami Disaster. Table 2 shows the name of communities conducted resettlement

project supported by national government. All the recovery projects completed within one year.

Table 1. The 1933 Syowa Tsunami Recovery Plan (Source: Department of Urban Planning, 1934)

	Location	Road	Tsunami Protection	Resettlement Site
Urban Area	Recovery at original location. Residential area mover to higher ground. Storage, and transportation industry stays at sea side.	Road network with the other cities and villages is the core of road network within the area. Width of road should consider tsunami evacuation and fire proof. Road from resettlement sit to the sea side need to be secured.	Making mound for minor impacted are. Sea wall and sea reclamation will be done for tsunami protection. Unti seismic and tsunami structure will be constricted at sea front to prevent wooden structure building behind.	
Fishery and Farming village	Village move to higher ground near from original location. Condition of resettlement site is as follows: 1) Near from the sea, 2)Higher than tsunami inundation heights, 3)Sea view, 4) South facing hill, 5) Drinking water	Road network between villages need to be tsunami safe heights to prevent isolation of villages.	Sea wall, buffer zone, and evacuation road will be installed for non-resettled villages.	Public facilities such as Village office, schools, police, temples should be located the highest location in the site. Community park locates at the center of resettlement site, and meeting hall and public bath is around the park. Resettlement site should accommodate all the villagers who would move to higher ground in the future. Tsunami inundation area will be used for common working space for



Figure 2. Site plan of resettlements: Left: Funakoshi, Yamada, Iwate, Middle: Kirikiri, Ootsuchi, Iwate, and Right: Ootani, Motoyoshi, Kesennuma, Miyagi (Source: Department of Urban Planning, 1934)

Table 2. Community Resettlement Project supported by National Government
(Source: Department of Urban Planning, 1934)

Miyagi Prefecture	Karakuwa Village: Yadoura, Jyuusan Hama Village: Aikawa Tanoiri, Oohra Village: Tanigawa, Koamikura, Onagawa Town: Ishihama, Tsuka Hama + Koiehama, Jyuugo Hama Village: Murokoshi, Funawatari, Okatsu, Nafuri (total 11 communities)
Iwate Prefecture	Kesen Town: Osabe, Hirota Village: Rokugaura, Tomari, Kotomo Village: Tadaide, Suezaki Village: Tomari, Hosoura, Akazaki Village: Syuku, Ryouri Village: Minato, Ishihama, Tanohama, Shirahama, Yoshihama Village: Hongo, Touni Village: Hongo, Koshirahama, Katakishi, Hanatsuyahama, Karaishi Town: Futamura, Kitsunezaki, Bouzuyama, Ureshiishi, Unozama Village: Amaishi, Ootsuchi Village: Komakura, Sougawa, Yasuwatari, Kirikiri, Funakoshi Village: Tanohama, Maesuga, Taro Town: Taro Otsubu, Omoto Village: Omoto, Tanohata Village: Torinokoshi, Hiraiga, Fudai Village: Ootanabe, Taneichi Village: Yagi, Oohama, Kawajiri (total: 38 communities)

3. DAMAGE OF THE EAST JAPAN EARTHQUAKE DISASTER AT RESETTLEMENT SITE

3.1. Damage in Resettlement Sites

Field survey of resettlement site of Meiji and Syowa Tsunami Disaster was conducted. Twenty one large scale resettlement sites were selected for the target of survey. Table 3 show the results of field survey.

Four types of damage pattern were clarified from the field survey at resettlement sites.

- 1) No damage (◎): Aneyosi settlement, which is famous for a stone monument saying that villagers should not live under the monument, did not get any damage in spite of the highest tsunami inundation of this event.
- 2) Slight damage (○): Resettlement site of Meiji tsunami stayed in higher ground and did not suffer from major damage.
- 3) Major damage in expanded lowland settlements (△) : Syowa resettlement community have expanded their settlement to lower land and got damage, though no damage in resettlement site.
- 4) Major damage in resettlement site (×) : Even the Syowa resettlement site in higher ground got damage for unexpected scale of Tsunami.

3.2. Resettlement Site without Damage

Only one community which did not suffered from damage is Aneyoshi in Miyako. Name of Aneyosi cannot find in table 2, but people individually moved to higher ground (Yamaguchi, 1943). Tsunami inundation height at this community is 38.9m, which is the highest inundation height in this event. This community is famous for a stone monument saying “You shall not live under this monument”. Even the 38.9m inundation tsunami did not reach this monument, and this community did not get any damage from tsunami this time.

3.3. Resettlement Site with Slight Damage

Even the community staying in resettlement site in higher ground and not expanding to lower ground got minor damage from tsunami. It is because the height of resettlement site is decided only from the experienced tsunami height. However, damage in these communities is very limited. Some houses near from the sea got damage. Two resettlement sites of Meiji and Syowa Tsunami Disaster correspond to this type of damage, Funakoshi (Yamada, Iwate) and Ootani (Kesenuma, Miyagi). Photo 2 shows damage in those communities.

Table 3. Damage of resettlement sites for the EJED

Village	Summary	Damage	Date of Survey
Onappe (Sakiyama, Miyako, Iwate)	Residential area have stayed in higher ground and no damage for housing. Fishery facilities at sea side got damage.	○	13-Aug-11
Aneyoshi (Shigemori, Miyako, Iwate)	No damage in spite of the highest inundation reaching to 40m. Famous village for stone monument saying no residents under the monument	◎	11-Aug-11
Funakoshi (Yamada, Iwate)	Though Sea wall got damage, Minor damage to residential area because people have stayed in resettlement site of Meiji and Syowa recovery.	○	11-Aug-11
Tanohama (Yamada, Iwate)	Damage at sea wall and residential area in lowland got severe damage. Resettlement site of Syowa recovery survived without minor damage.	△	11-Aug-11
KiriKiri (Ootsuchi, Iwate)	Resettlement site of Syowa recovery got damage but housing in higher ground survived.	△	11-Aug-11
Ryouishi (Kamaishi, Unozumai, Iwate)	Sea wall was destroyed. Resettlement site of Syowa recovery got severe damage.	×	14-Aug-11
Hongo (Karani, Kamaishi, Iwate)	No damage in resettlement site of Syowa recovery, but expanded lowland residential area got severe damage	△	14-Aug-11
Koshirahama (Karani, Kamaishi, Iwate)	Sea wall was destroyed, and residential area in lowland got severe damage. Resettlement site of Syowa recovery was safe.	△	14-Aug-11
Urahama (Okirai, Oofunato, Iwate)	All the village got severe damage. Resettlement of Syowa recovery also got severe damage.	×	18-Oct-11
Minato (Ryori, Sanriku, Oofunato, Iwate)	Residential area in low land got severe damage. Resettlement site of Syowa recovery did not get any damage.	△	18-Oct-11
Syuku (Akazaki, Oofunato, Iwate)	Residential area in low land got severe damage, and slight damage in resettlement site of Syowa recovery.	△	17-Oct-11
Hosoura (Suezaki, Oofunato, Iwate)	Residential area in low land got severe damage. Resettlement site of Syowa recovery did not get any damage.	△	17-Oct-11
Tomari (Suezaki, Oofunato, Iwate)	Residential area in low land got severe damage. Resettlement site of Syowa recovery stays in minor damage.	△	17-Oct-11
Tomari (Rikuzentakada, Iwate)	Resettlement of Syowa recovery was safe. Minor damage in residential area in sea side.	△	17-Oct-11
Osabe (Rikuzentakada, Iwate)	Reclaiming land and sea wall of Syowa recovery did not work. All the villages got severe damage.	×	17-Oct-11
Oosawa (Karakuwa, Kesenuma, Miyagi)	Resettlement and lower land housing got severe damage.	×	17-Oct-11
Tadakoshi (Karakuwa, Kesenuma, Miyagi)	Housing in lowland got severe damage No damage in resettlement of Syowa recovery.	△	17-Oct-11
Ootani (Motoyoshi, Kesenuma, Miyagi)	No damage in resettlement site of Meiji and Syowa recovery. Mainer damage at houses near from the sea.	○	17-Oct-11
Aikawa (Kitakami, Ishinomaki, Miyagi)	Residential area in lowland got damage. No damage in resettlement of Syowa recovery.	△	16-Oct-11
Tanigawa (Ojika, Ishinomaki, Miyagi)	Resettlement site of Syowa recovery got severe damage.	×	16-Oct-11
Okatsu (Ishinomaki, Miyagi)	Severe damage at residential area in lowland. Minor damage in resettlement site of Syowa recovery.	△	16-Oct-11

These two communities resettled to higher ground after Meiji Tsunami, and damage at the time of Syowa Tsunami was limited. Only residents in lowland, 24 housing units at Funakoshi, and 27 housing units in Ootani got damage. People have stayed in higher ground since Meiji recovery. Another point about these communities is location of community centre. These communities are facing to national highway, which runs higher ground, and business area locate along the highway.

From cases of these two communities, it can be said that 1) business area in higher ground along national highway, 2) success story of resettlement at the time of Syowa Tsunami Disaster could keep people staying in higher ground. And it would work to reduce damage from the EJED.



Photo 1. Aneyoshi community, Left: tsunami impact at the bay, tsunami inundated up until 38.9m, Middle: a stone monument saying no residential area under the monument, Right: Aneyoshi community after the EJED.



Photo 2. Meiji Resettled Community, Left: Funakoshi, No residential use in low land, Middle: Funakoshi community after the EJED, Right: Ootani community

3.4. Major damage in expanded lowland settlements

Large scale Syowa resettlement site correspond this type of damage. Though there was no damage in the resettlement site at higher ground, expanding residential area in lowland suffered from devastating damage. Figure 2 shows the site plan of Syowa resettlement and impacts from the EJED.

Yaichiro Yamaguchi, who is anthropologist monitoring the resettlement sites in this area, points out reasons why people live in lower land near from the sea (Yamaguchi, 1943). One is shortage of land after the World War II. People moving back from outside Japan settled in lowland because they did not have housing lot in resettlement site. The other reason is a big catch of fish. Those who got big money constructed their new house at the original lot near from the sea.

Resettlement site of Syowa Tsunami Disaster have about eighty years history. Environmental condition of resettlement site looks nice. Tanohata community (Upper Right) got severe damage in lower part, but main part of resettlement site was safe. Basic layout of resettlement in Syowa has been kept, and several shops exist in resettlement site. Situation of Hosoura community (Upper Left) is same with Tanohata.

Hongo community have excellent layout. cherry trees were planted at the boundary of resettlement site, and lowland, though several houses located in lowland got damage. And Aikawa community have

interesting feature. Name of bus stop in resettlement site is still “resettlement site”.

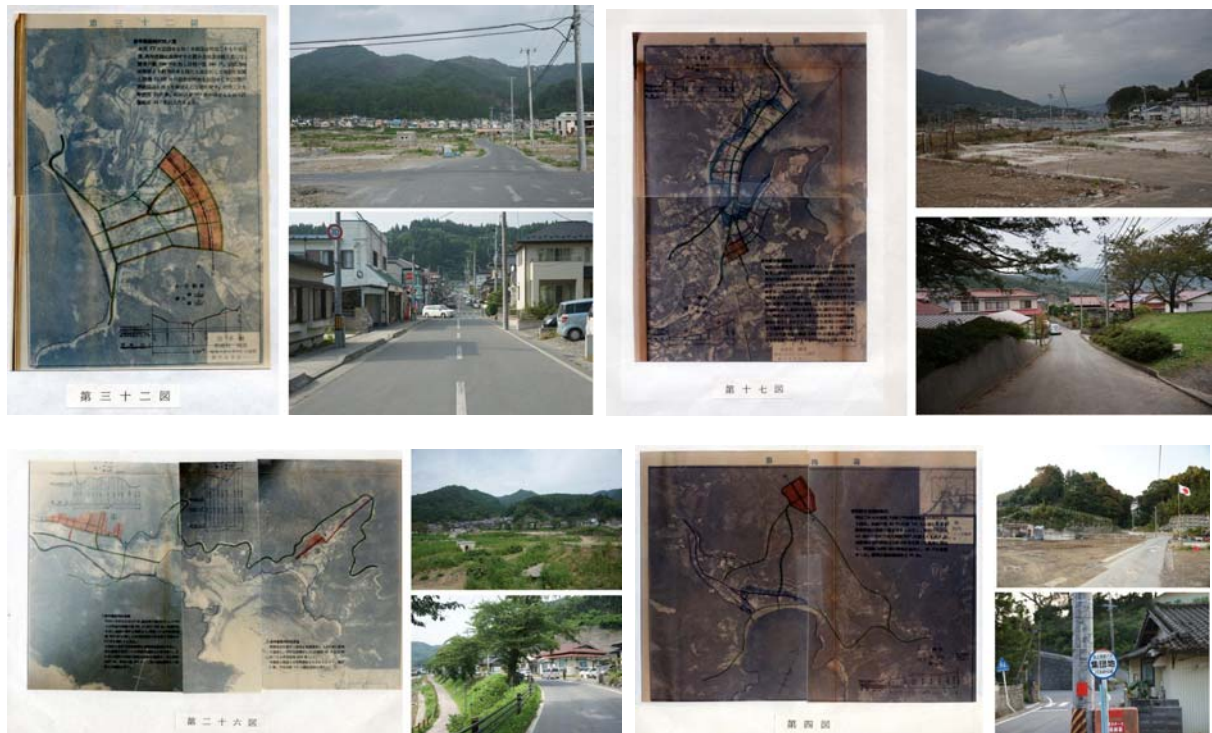


Figure 2. Syowa Resettlement, Upper Left: Tanohama, Yamada, Iwate Upper Right: Hosoura, Oofunato, Iwate, Lower Left: Hongo, Karani, Kamaishi, Iwate, Lower Right: Aikawa, Kitakami, Ishinomaki, Miyagi

3.5. Major Damage to Resettlement Site

Some resettlement site of Syowa suffered from devastating damage even at the resettlement site of higher ground. Recovery projects and damage from the EJED are shown in Figure 3. Ryoishi in Kamaishi (Left), Urahama in Okirai, Oofunato, Tanigawa in Ojika, Ishinomaki correspond to this damage type. And Osabe in Rikuzentakada (Right) made both mound and sea wall for tsunami protection after Syowa Tsunami Disaster, but those tsunami protections could not save community. Tsunami of the EJED was far beyond the height of Meiji and Syowa at those communities.



Figure 3. Syowa Resettlement suffered from devastating damage, Left: Ryoishi, Kamaishi, Iwate, Right: Osabe, Rikuzentakada, Iwate

4. COMMETNS AND DISCUSSION

Concept of recovery plan of the EJED in 2011 is not new. It is just repeating the scheme of tsunami recovery in Syowa. So it is important to learn from the damage in resettlement site. Point to complete successful recovery is how to regulate the residential area expansion to lowland. Even at the time of Syowa recovery, Miyagi prefecture set the ordinance to regulate the construction of housing in lower land. In spite of land use regulation, people move back to lower land near from the sea, and suffered from tsunami damage again.

One interesting example of resettlement project is resettlement site of Meiji Tsunami Disaster. Community center has moved to higher ground because of national highway construction, and people did not move back to lower ground. It can be said that new business opportunity was developed because of national highway. So it is very important to make new business opportunity in resettlement site, and those businesses could keep people at the resettlement site.

Tsunami risk in western part of Japan is high. Possibility of Tonankai and Nankai earthquake within 30 years are 50-60%. Tsunami risk area in western part of Japan also periodically was hit by tsunami. Scale of Syowa Tonankai and Nankai earthquake was small, and tsunami inundation was not so severe. So that residential area spread in lower land in tsunami risk area in western part of Japan, not like Tohoku area. Based on tsunami impact in 2011, national government reevaluated tsunami height of Tonankai and Nankai earthquake. According to the revised tsunami simulation, over 30m tsunami will hit Kochi Prefecture (Cabinet Office, 2012). And tsunami arrival time is very short about Tonankai and Nankai earthquake, first tsunami wave reach to Shionomisaki, Wakayama, where city center locates in lowland, within several minutes. In addition to resettlement projects for recovery from the EJED, resettlement project in tsunami risk area for Tonankai and Tokai earthquake is also important. Key for those resettlement projects is how to install new business opportunity at resettlement site, and sharing success story of resettlement in higher ground among residents.

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