

## Brief explanation on the regional characteristics of Sanriku Coast

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Regional outline of Sanriku Coast where coastal settlements had catastrophic destruction by the tsunami is presented, including its location, history, main local industries, tsunami damage, and prospects for the recovery.

### 1. Introduction

As presented in the beginning two chapters reported by the author, Sanriku Coast is the most severely damaged region by the East Japan Earthquake and Tsunami on March 11, 2011. The most part of the coast was hit by huge tsunami with the height of 10m or more at the shoreline, and was inundated up to 3 km from the shore in the most intensive cases<sup>★1</sup>. Such severe natural phenomena caused heavy damages beyond any expectations.

The name of “Sanriku” originally means three ancient regions of Rikuzen (mainly Miyagi Prefecture), Rikuchu (mainly Iwate Prefecture), and Mutsu (mainly Aomori Prefecture), all of which contain “riku (陸)” in their Japanese character. But now “Sanriku” is used identical to “Sanriku Coast”. It was owing to former catastrophic phenomena occurred in more than a hundred years ago.

### 2. Physical setting and tsunami disaster

Generally called Sanriku Coast is the coastal area along the Pacific shore with rugged and indented coastline mainly from Hachinohe to Ishinomaki in northeastern Honshu (Fig.1). It is well-known as a typical “Rias” type of coastline in Japan’s school education. Such shape of coast finds usually the adequate place for the harbor with deep bay and calm wave. Actually many of people inhabited there depending mainly



Fig.1 Location of Sanriku Coast

on seaports which enable to utilize the marine resources from their frontal sea. And it was fortunate for the people to have a lot of benefit from the sea where warm current (Kuroshio) and cold current (Japan Stream) meets brings rich marine fishery resources.

As is usually the case for the Rias type of coast including Sanriku, hilly landform with limited flatlands can only allow the settlements to locate near shore often in the bottom of narrow bays. Tsunami wave easily rise bigger in such bays, and shoreline settlements can be easily affected by it. Unfortunately, Sanriku Coast lies parallel to the Japan Deep where the Pacific Plate moving beneath the Japan Archipelago which causes cyclical but virtually sudden thrust of micro plates triggering huge tsunami. After the Meiji Restoration, Sanriku Coast suffered from severe tsunami damages in 1896 and 1933. The name of “Sanriku” became well known firstly in modern Japan by the newly established newspapers reporting severe tsunami damage in the coastal area of Sanriku region in 1896. It was generally believed as a reason “Sanriku” became in use for the same meaning of “Sanriku Coast”. Even in pre-modern age, archive documents told some big tsunamis gave damages to coastal area in Sanriku, among which the events happened in 869 and 1611 were significant ones followed huge damages.

### **3. History of local economy**

Sanriku Coast was known historically as a shipping area of such special products as dried abalone, sea cucumber and shark fin, which were shipped to Yedo (ancient name of Tokyo) and some of them were exported to China. In the period of Japan’s industrial revolution mainly in 1910-1920’s, advanced fishing boats and methods developed mainly in Europe were introduced to this area, by which some towns in the harbors grew up to the base ports for off-shore fishing. Hachinohe, Miyako, Kesenuma, Onagawa and Isinomaki shown in Fig.1 are such base ports. During the period of Japan’s High Economic Growth in 1960-70’s, these fishing ports rapidly grew up as the bases for far-sea fisheries including tuna long-lining, salmon drift net, and trawl net in the northern Pacific or other seas in the world. In addition, technologies of aquaculture for “wakame” seaweed, laver, and oyster were developed in inshore bays or inlets mainly after 1950’s.

After the latter half of 1970’s, when the Oil crisis came and the exclusive economic zone was introduced in Japan and some of its adjacent countries, the far-sea fishery began to decline, resulting the long-term reduction of fishery catches in major fishing ports in Sanriku (Fig.2). Worldwide factors such as the exhaustion of fish resources by over exploitation and the so-called “Regime Shift” in the environment system are another causes of such change in marine resources.

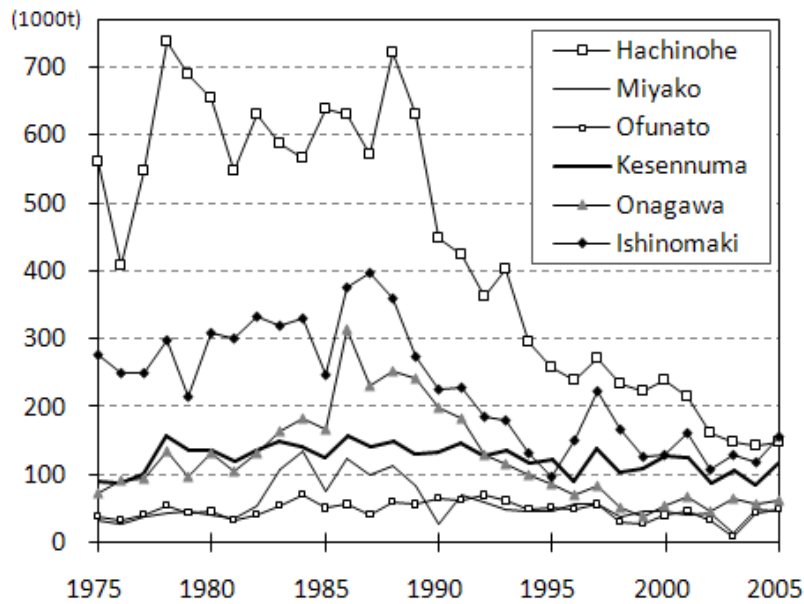


Fig. 2 Change of unloaded fishes by major base port in Sanriku Coast  
source : National Census of Fishery

#### 4. Population

Because of above mentioned regional background, population in Sanriku Coast concentrated in some towns or cities which have major fishing ports, and population density is totally lower in comparison with the inland area (Fig.3). Since 1970's, the population turned to decrease owing mainly to the reduction of far-sea fishery. Population of the most of municipalities in Sanriku coast decreased from 1970 to 2000, while it increased in 8.7% totally in Tohoku Region. The most depopulated was Oshika (now a part of Ishinomaki City) with -50.1%.

At the same time, aging of population has advanced. Ratio of the population with 65 years old and over surpassed the Tohoku's average of 20.3% in most of municipalities; the highest is 33.4% again in Oshika.

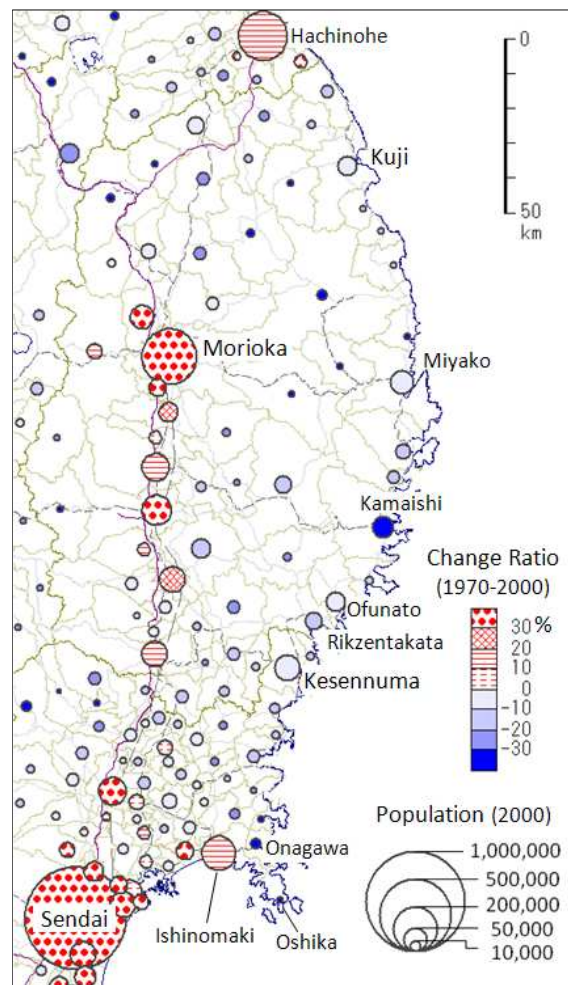


Fig. 3 Population distribution and change  
source: National Population Census

## 5. Fishery and related industries

In spite of the long term reduction, local economy of Sanriku Coast inevitably depends largely on fishery and its related industry, because of limited agricultural production owing to narrow flat lands and frequently appearing cold summer. In addition, the remote location from the arterial transportation lines of Tohoku Expressway and Shinkansen became unfavorable regional factor for the development of other industries than fishery even during the Japan's rapid economic growth. By such background, fishery in Sanriku Coast keeps a status of the major local industry, and Sanriku is still one of Japan's major fishery regions seated some major fishing ports (Fig.4).

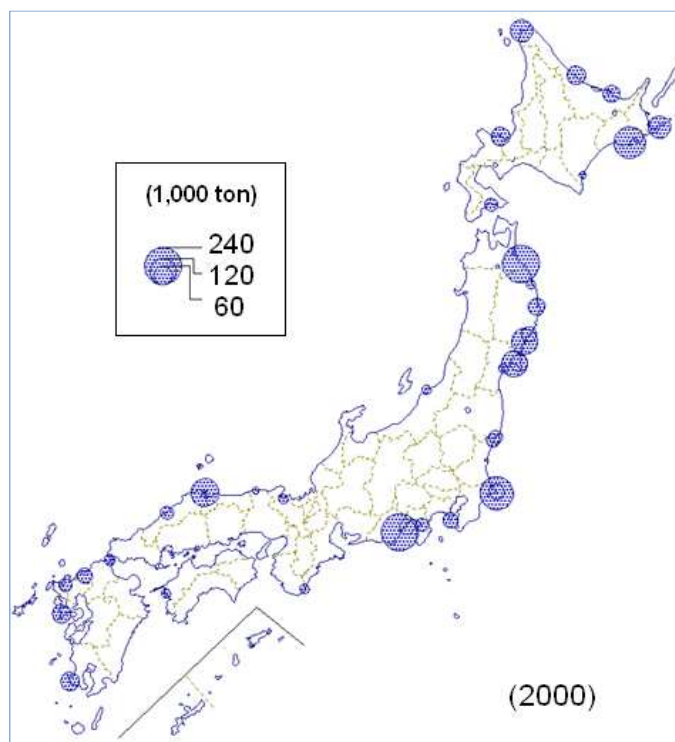


Fig.4 Unloaded fishes (t) by major ports in Japan  
source : National Census of Fishery

Table 1 Sanriku's share in Japan for main fishery resources

	Aomori *	Iwate	Miyagi	sub total	share in Japan(%)
<b>fishing</b>					
Tuna	3,532	6,684	29,636	39,852	16.7
south tuna	63	310	1,724	2,097	34.3
marlin	340	712	5,064	6,116	31.6
shark	1,012	2,351	23,735	27,098	75.2
saury	4,054	15,765	32,230	52,049	22.2
cod	1,966	9,105	12,236	23,307	47.5
red fish	60	9	535	604	81.7
rock fish	333	71	302	706	49.5
krill		20,677	20,287	40,964	89.0
abalone	34	231	156	421	23.8
squid	81,685	19,626	14,241	115,552	35.0
urchin	836	1,524	894	3,254	27.1
<b>aquaculture</b>					
silver salmon			9,174	9,174	99.6
oyster		12,337	56,669	69,006	30.7
ascidian		1,828	10,079	11,907	95.4
kelp	399	12,804	2,163	15,366	30.1
wakame	13	24,704	18,743	43,460	72.6
<b>Total Catch</b>	<b>140,465</b>	<b>145,101</b>	<b>278,691</b>	<b>564,257</b>	<b>12.7</b>

\* : Pacific coast Source : Annual report for fishery and aquaculture (2005)

Table 1 shows how Sanriku Coast plays important role in Japan's fishery, where we can grasp that many of Sanriku's fishery resources have significant shares in the national total. In addition, major fishing ports have fishery related industries to distribute the unloaded resources to other region, to process them, to repair fishing boats, and to support to preparation for the next leave. Table 2 shows some of such functions estimated using the national censuses. Actually, more other fishery related industries are usually located in fishing port, including various types of service for the fishing, shipping, fishermen, and administrative services. We should recognize the major fishing ports in Sanriku hosted functional complexes of such fishery and its related industries.

Table 2 Fishery related industries in major ports in Sanriku

	Seafood processing		cold storage		ice making		ship building and repair		wholesaling for fish and shellfish		retailing for fish and shellfish		Total	
	factory	worker	plant	worker	factory	worker	factory	worker	shop	worker	shop	worker	worker	
Hachinohe	88	3,872	89	3,647	5	45	18	414	69	577	81	260	350	8,815
Miyako	48	1,206	52	1,114	3	20	6	25	13	89	31	158	153	2,612
Kamaishi	16	401	18	493	1	2	6	51	14	73	28	85	83	1,105
Ofunato	31	1,202	33	1,162	0	0	13	96	31	196	35	85	143	2,741
Kesennuma	96	3,417	64	3,009	4	53	26	225	91	887	33	109	314	7,700
Ongawa	32	1,199	25	1,106	3	49	1	1	8	171	16	39	85	2,565
Ishinomaki	115	3,868	83	3,188	5	36	33	393	74	910	59	181	369	8,576
Sub Total	426	15,165	364	13,719	21	205	103	1,205	300	2,903	283	917	1,497	34,114
Sanriku Total	526	17,531	439	16,001	25	212	128	1,395	347	3,313	369	1,183	1,834	39,635

source : National Census of Fishery (2008), National Census for Establishment (2006)

## 6. Damages

As shown in the previous chapters and as informed widely by the TV or internet, damages caused the East Japan Earthquake and Tsunami in Sanriku Coast was catastrophic. In this section, brief outline of the damages will be reviewed.

### 1) Human and housing

Fig.5 shows human damages by municipality. The highest ratio of dead and lost people to the population is Otsuchi (9.48%), and the next three are Onagawa (9.44%), Rikuzentakata (9.08%), Minami-Sanriku (5.66%). All of these are located at the bottom of narrow bays in Sanriku Coast. The municipality with the worst number of human damages (3,153 dead and 890 lost) is Ishinomaki City, where not only many of fishing villages but also the densely populated urban area were flooded away by up to 10m-high tsunami.

Fig.6 shows the number of completely and half-destroyed houses. The intensity of earthquake was so severe and wide this time, the large number of damaged houses appear not only in tsunami affected coastal area, but also in inland area such as Koriyama City and suburban Sendai. But the

ratio of “completely” destroyed houses are high especially in the coastal region suffered from severe damage of tsunami.

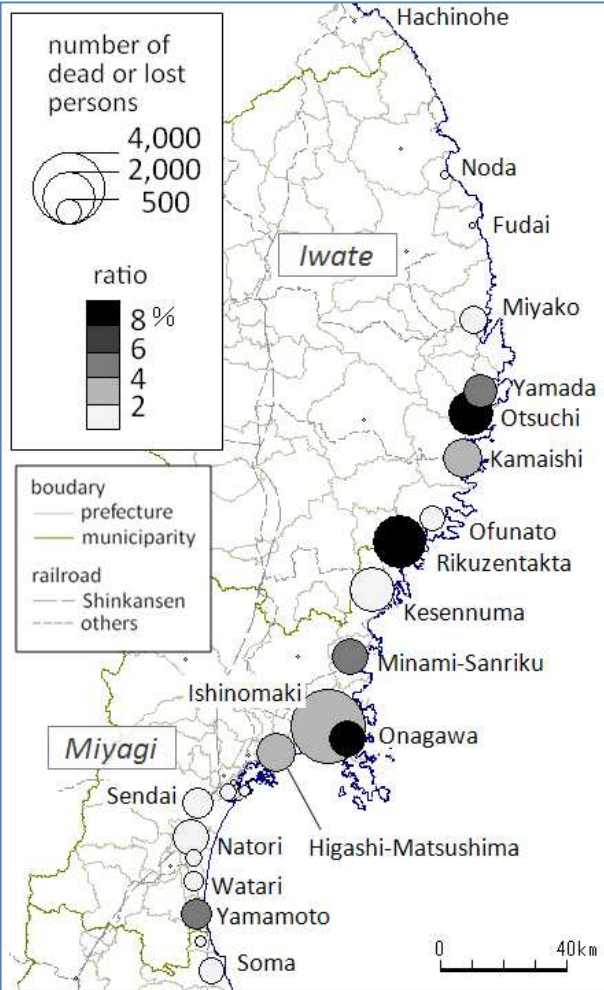


Fig.5 Died and missing persons by municipality (August,11)

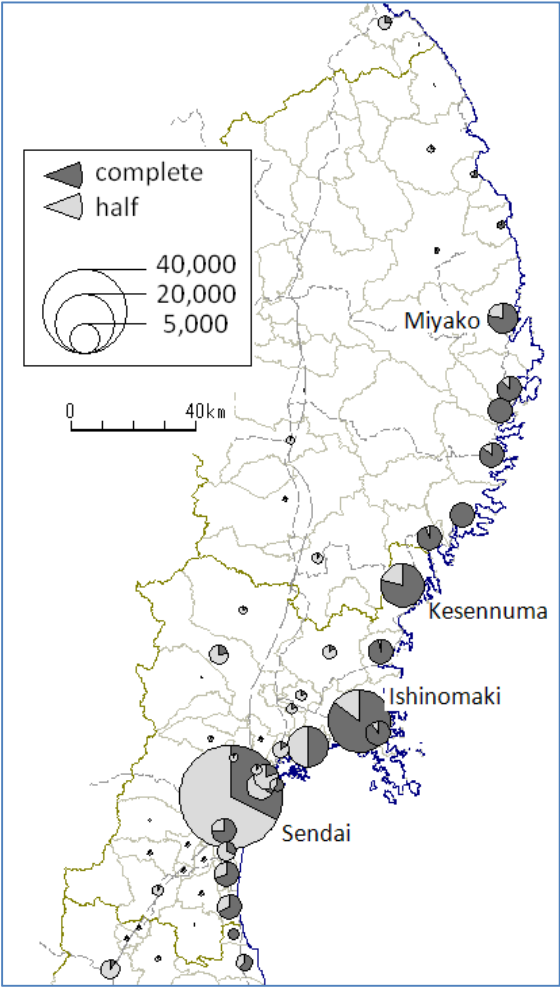


Fig.6 Destroyed houses (August,11) source: National Fire Defense Agency

**2) Damages for fishery**

Among all industries in tsunami affected regions, fishery and relating marine product industries got the most devastating damages. Table 3 and 4 show that the fishery and relating facilities in the three prefectures were almost completely destroyed. Especially, Iwate and Miyagi, which are located in Sanriku Coast, are (or “were”) one of the most thriving fishery areas in Japan. Most of the fishing ports in this area lost almost all facilities relating to fishery and marine products.

As for marine products processing factories shown in Table 4, about 80% of factories were destroyed in Iwate and Miyagi, because most of such factories were located near fishing port and destroyed or flooded away by tsunami.

Table 3 Damages for fishery and relating facilities in three severely damaged prefectures

	fishing port			fishing boat				fishery market			aquaculture	
	total number	damaged ports	lost value	registered boats (2007)	damaged boats	ratio to registered boats	lost value	total number	damaged markets	lost value	lost facilities	lost products
	million yen			%				million yen			million yen	million yen
Japan Total	730	319	823,040	224,063	25,852	11.5	161,392	105	61	32,785	74,135	57,517
Iwate	111	108	285,963	14,177	10,522	74.2	15,842	13	13	14,290	13,200	11,000
Miyagi	142	142	424,286	12,627	12,018	95.2	112,900	10	10	10,577	48,700	33,189
Fukushima	10	10	61,593	1,060	873	82.4	6,639	12	12	3,188	280	516
ratio (%) of three prefectures to Total	36.0	81.5	93.8	12.4	90.6		83.9	33.3	57.4	85.6	83.9	77.7

Japan Fisheries agency (<http://www.maff.go.jp/j/press/keiei/saigai/110816.html>)

Table 4 Damages for marine products factories in three prefectures

	total (2008)	completely damaged factories	half damaged factories	ratio of damaged factory	lost value
				%	million yen
Japan Total	2,108	540	129	31.7	181,746
Iwate	178	128	16	80.9	39,195
Miyagi	439	323	17	77.4	108,137
Fukushima	135	43	9	38.5	24,710
ratio (%) of three prefectures to Total	35.7	91.5	32.6		94.7

Japan Fisheries agency (<http://www.maff.go.jp/j/press/keiei/saigai/110816.html>)

### 3) Damages for manufacturing factories

Not only the fishery and related industries, but also any industries in tsunami affected area assumed to suffer severe damages. Table 5 shows the manufacturing factories located in tsunami affected area in three prefectures. More than one thousand factories in total were located there. Among three prefectures, Miyagi assumed to have the most severe damage, of which ratio to all factories reach 16.4% in number of factories, and 14.4% in workers, and 21.9% in output value. In Miyagi prefecture, many of factories were located in the industrial estates developed near port areas, such as the case of marine product factories' estates in Kesenuma, Ishinomaki and Shiogama, Sendai Port industrial park, and Sendai Airport industrial estate.

Table 5 Damages for manufacturing factories in tsunami affected area

	number of factories in tsunami	ratio(%) to all factories	number of workers in tsunami area	ratio(%) to all factories	output value (billion yen) in tsunami area	ratio(%) to all factories
Iwate	164	4.2	3,592	3.6	7,440	2.9
Miyagi	850	16.4	18,430	14.4	77,960	21.9
Fukushima	77	1.0	1,692	0.9	5,910	1.0

Ministry of Economy, Trade and Industry (<http://www.meti.go.jp/statistics>)

## 7. Reconstruction

Every damaged municipalities in Sanriku Coast published each redevelopment plan by the end of 2011. Each of them basically contains three major tasks; reconstruction of whole infrastructure, recovery of local business and industries, and creation of disaster preventive community. But there has appeared many difficulties. A case of Onagawa Town will be presented here.

Onagawa Town of which registered population was 12,000 in 2010 located at the south of Sanriku Coast (Fig.1). Struck by the huge tsunami with the height of 17-23m above sea level, almost entire part of its central part and main port, which faced at the bottom of a narrow bay, was destroyed and flooded away (Fig.7). 541 people which is rated 5.4 % of the total population died or lost, and about 4,300 houses and buildings were destroyed. Not only the central area, but also many of the fishery villages were severely destroyed.



Fig.7 Tsunami affected area (bold line) with tsunami height (m)

affected area : Geographical Information Authority, tsunami height: Tsunami Control Center of Tohoku University



Town's redevelopment plan was published on September, 2011, containing much of projects to create whole town as shown in Table 6.

Table 6 Projects for recovery and redevelopment

<p>&lt;&lt; Disaster prevention &gt;&gt;  Creation of safe and secure port town</p> <ol style="list-style-type: none"> <li>1 rehabilitation of infrastructure in port area</li> <li>2 remaking for evacuation plan from the tsunami</li> <li>3 centralization of the facilities for disaster prevention</li> <li>4 enhancing the function of the public facilities as shelters</li> <li>5 remaking the roads' network for preventing the disasters</li> <li>6 creating the self-helping energy system</li> <li>7 promoting the community power against the disasters</li> <li>8 preservation for the relicts of the tunami</li> <li>9 remaking the regional plan for disaster prevention</li> </ol>
<p>&lt;&lt; Industries &gt;&gt;  Regeneration and redevelopment of the port town industries</p> <ol style="list-style-type: none"> <li>1 first aid rehabilitation and early restart of the fishery</li> <li>2 redevelopment for the port function and the fishery</li> <li>3 rehabilitation for the commercial and manufacturing industries</li> <li>4 creation for new employment</li> <li>5 rehabilitation and creation for the tourilism</li> <li>6 creation of the research center for marine science and technologies</li> </ol>
<p>&lt;&lt; Living environments &gt;&gt;  Creation of high quality of life</p> <ol style="list-style-type: none"> <li>1 urgent construction for the temporary housing</li> <li>2 creation for the safe residential area in the town center</li> <li>3 creation for the safe residential area for the villages</li> <li>4 provision for the permanent housing</li> <li>5 restart and maintainance for the public transportation</li> <li>6 promoting the health and life time sports</li> <li>7 restoration of the histric sites and traditional cultures</li> <li>8 promoting the healthy town both mentaly and physically</li> </ol>

[http://www.town.onagawa.miyagi.jp/hukkou/iinkai\\_04.html](http://www.town.onagawa.miyagi.jp/hukkou/iinkai_04.html) (September 11, 2011)

They were supposed to be accomplished by 2018, which was divided three periods below;

i) period of urgent recovery (2011~12) : provision of temporary shelters, land designation for the planning, reopen of main port and fish market, restart of aquaculture, construction of temporary shops and factories etc.

ii) period of construction for infrastructure (2013~15) : development of new town center and residential estates, ground raising of main port and downtown area etc.

iii) period of completion of redevelopment (2016~18) : completion of new residential area, permanent shops and factories, and all projects to create new Onagawa

Image map of a reborn town center is telling us a hopeful future of Onagawa Town (Fig. 8)



Fig.8 Image map (source : ibid)

## 8. Difficulties and prospects

Difficulties to realize the plan would be many. At first, how the agreement among various landowners and inhabitants can be achieved, after deciding to abandon their home places and to move new places. In the second, how the huge cost can be raised in order for the people to pay from their own limited properties. The third and most urgent difficulty is to provide the employment opportunities for the people who lost all their living fundamentals. Without any earnings, it would be unavoidable for the people to move out of the town before the projects can be achieved. Though the fishery activities which was main local industry in the town partly resumed by the end of 2011 (Table 6), it is far limited in comparison with the before.

Every damaged towns and cities share such situation and difficulties. The author believes that long-term supports and concerns for the region would be necessary until every community can finally recover and create alternative living culture enough defensive against cyclically coming tsunami disaster.