Reconstruction after the 311 East Japan Earthquake

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INTRODUCTION

In the countries under high risks of natural disasters such as Japan, the mitigation of disaster damages is critically important when sustainable living place is considered. The most important lesson from the experiences of the 311 East Japan Earthquake from this viewpoint is that "living at the vulnerable place should be avoided". In Japan, during the time of rapid population increase and urbanization, rather vulnerable low-land areas or hilly areas with high risks of natural disasters have been developed and DID (densely Inhabited District) expanded rapidly while population density had been continuously decreasing (Fig 1 & 2).

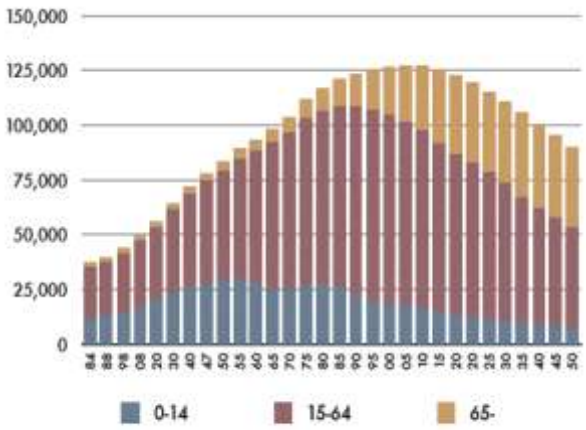


Fig. 1 Trends of Population by Age in Japan

Source:国土交通省（2011）

Fig. 2 Trends of Population in DID (Densely Inhabited District)

In the case of Ishinomaki city which was most affected by tsunami on 3.11, the urbanization promotion area, which is the area where urban development is promoted in the Japanese planning system, is designated in the coastal areas hit by tsunami and these places were devastated by tsunami. In the case of Sendai city which was also seriously affected by tsunami, the most coastal areas except for the Sendai Port area are designated as the urbanization control area where urban development is restricted, yet, in some areas the district plan which allow development is designated under deregulation and those areas are hit by tsunami.

Yet, today, since the population of Japan has already started declining, smart shrinking, in particular, from such vulnerable areas is one of the most urgent issues in order to pursue sustainable living. In this sense, it can be said that the reconstruction from the 3.11 East Japan Earthquake will be a touchstone to reconsider national land use in the time of population decrease.

In the reconstruction process after the 3.11 East Japan Earthquake, damaged communities are planned to be relocated to safer places, yet there are many issues to be solved. The relocation itself has not started yet due to the difficulty of consensus making among residents. In addition, region-wide consideration such as economic revitalization as well as the provision of public services such as hospitals and educational facilities is not yet fully considered in the reconstruction plan. In this paper, the current situation of reconstruction plans and projects after the 311 East Japan Earthquake as well as the issues faced in its process will be discussed in details.

DAMAGES CAUSED BY 3.11 EARTHQUAKE

The Pacific side of the Tohoku region has been repeatedly hit by large tsunami causes by earthquakes in the past: 1896, 1933, 1960 in the past 150 years. In particular, the deaths and missing at the time of 1896 tsunami reached 22,000. Damages caused by 3.11 earthquake and tsunami are summarized in Table 1. Though large-scale structures as seawalls have been constructed: the largest is the seawall constructed in the Kamaishi bay which were more than 60 meter from the

bottom of the sea, 8 meter height over the surface of the sea, 20 meter width and 2km length. But those seawalls were broken in vein except for few cases and the huge areas protected by seawalls were seriously damaged.

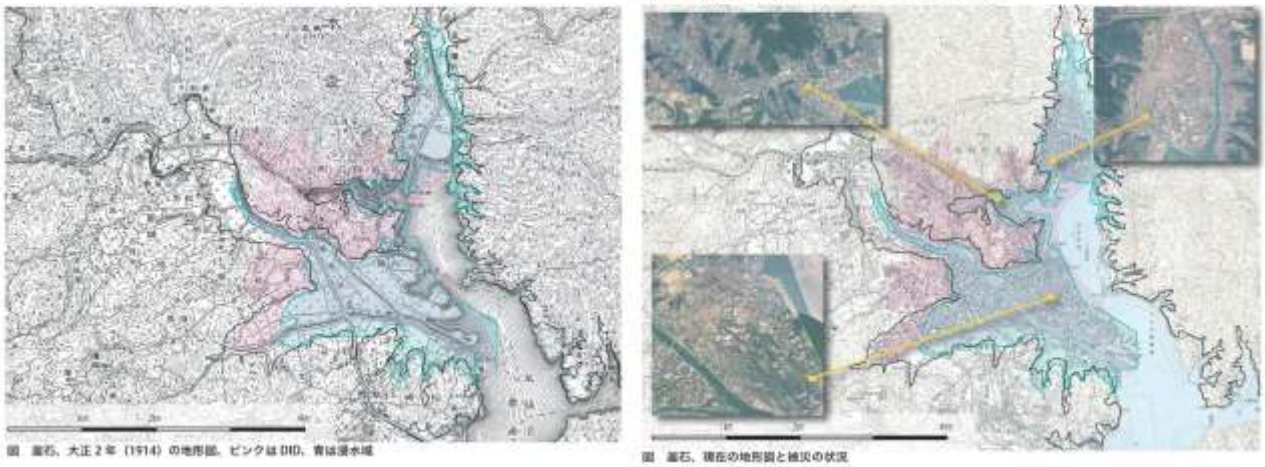
Table 1 Damages caused by 3.11 East Japan Earthquake

県名	市町村名	(A)人的被害	(B)全壊住宅：戸	**(A)100／(B)**	被災戸数：戸	浸水 Km^2
岩手	県合計	6035	20184	**29.8**	32052	58
宮城	県合計	11367	82754	**13.7**	423271	328
福島	県合計	1823	19770	**9.2**	223441	111
	（3県計）	19225	122708	**15.6**	678764	497
全国	全国計	19295	127185	**15.1**	1011704	561

出典：2011 年 12 月 30 日時点の警察庁報告、浸水面積は国土地理院。
注：人的被害は行方不明者と死者の合計。太字は全壊 100 戸当り人的被害。

Source: 安藤(2013)

It is noted that cities and towns in these areas have been expanded towards the seaside by developing paddy field or swamps during economic development. As shown in the Fig. 3, though the old town areas were also damaged in some cities, the areas newly developed were much larger than the old town areas.



Pink areas: Areas inundated by Tsunami on 3.11: Case of Kamaishi City
(Left: base map is the one of 1914, Right: base map shows the situation just before 3.11 tsunami)

Source: 国土交通省(2011)

Fig.3 The Areas Damaged by Tsunami: Case of Kamaishi City

CURRENT SITUATION OF RECONSTRUCTION

We received warm support after 3.11 East Japan Earthquake from over 150 countries. Thanks for the help, the region directly hit by tsunami gradually moving towards recovery, though the number of evacuators is as large as 327,000 at present. They are housed temporarily in the temporary houses or private rental dwelling where the rent is supported. 53,000 temporary houses have been provided in total.

Framework of Reconstruction

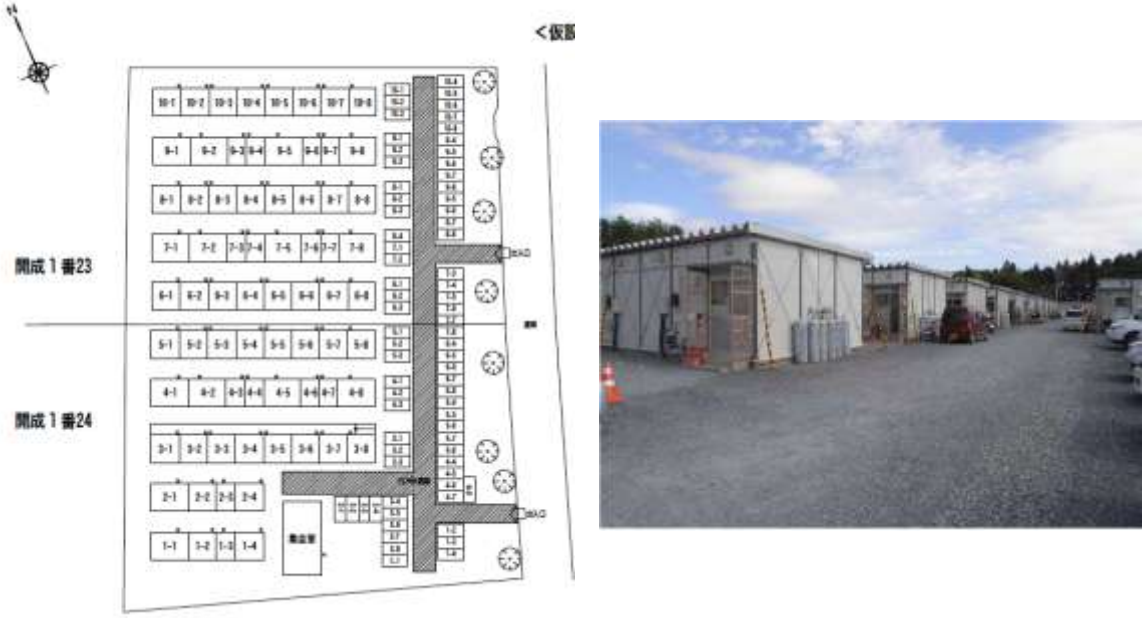
Though the Reconstruction Agency was at last established in Feb. 10, 2012 nearly one year after 3.11 Earthquake, there are a lot of problems ahead. The major events in the meantime are listed below:

- Establishment of the Reconstruction Design Council by the National Government, April 11, 2011
- 1st Supplementary budget for reconstruction on May 2, 2011 (4 trillion yen)
- Basic Law on the Concept and Organization for Reconstruction after the East Japan Earthquake, June 24, 2011
- 2nd Supplementary budget for reconstruction on July 25, 2011 (1.9 trillion yen)
- 3rd Supplementary budget for reconstruction on Nov. 25, 2011 (9.2 trillion yen)
- Special law for the issuance of national bond for reconstruction on Dec. 2, 2011
- Establishment of Reconstruction Agency on Feb. 2, 2012
- Budget for Reconstruction in 2012 (3.8 trillion yen)
- Establishment of the Reconstruction Agency on Feb 10, 2012

In the case of Hanshin-Awaji Earthquake of 1995, it took 3 years for the reconstruction of infrastructure 5 years for housing and 10 years for the recovery of population. Yet, socio-economic conditions of the areas hit by 3.11 Earthquake are much more serious since they are located in remote areas and thus the reconstruction will not be so simple. It is planned that at least 19 trillion yen will be poured to the damaged areas in the first 5 years which is designated as concentrated reconstruction period. Among them, 10.5 trillion yen is planned to be covered by the 2.1% increase of income tax for 25 years.

Temporary Housing

Temporary housing based on Natural Disaster Relief Act (1947) is to be provided by Prefecture Governments. The costs of provision of temporary houses are to be basically born by Prefecture Governments but the National Government is to bear the costs if the Prefecture Governments are not financially capable and thus they are actually born by the National Government. The length of use of temporary houses is to be not more than 2 years though it is possible to extend. The size is stipulated as 19.8 ㎡, 29.7 ㎡, 39.6 ㎡. Standard size is normally 29.7 ㎡. The typical layout used for the temporary housing sites is as shown in Fig. 4 and it has to be said that it is really very minimum-standard.



Source: Ishinomaki city

Fig. 4 Typical Layout of Temporary Housing Sites

On the other hand, the importance of *machizukuri* at temporary housing sites is increasing in order to regenerate community, livelihood, provison of basic living services such as health and welfare. One of such example is the case of the Hirata temporary housing site of Kamaishi city where 1) wood-deck ally to nurture the sense of community is introduced, 2) a day-care and support center is provided and connected to the wood-deck ally so that aged people can be well taken care, 3) not only temporary houses but also welfare and health services as well as temporary shops are located in the site, 4) a *machizukuri* association was

established in addition to the neighborhood association to that various stakeholders can collaborate each other (Fig. 5).

Source: Institute of Gerontology, the University of Tokyo

Fig. 5 Community-care Type Hirata Temporary Housing Site

Industry and Employment

The total population of the all municipalities along the Pacific-side coastal areas of Tohoku region had already decreased 47,000 during the 5 years of 2005 to 2010 before the 3.11 Earthquake (National Census date), while it drastically decreased 63,000 during one year after 3.11 Earthquake according to the Residents Registration data. The key to the recovery of population is the recovery of industry and employment. As for manufacturing industry the rate of recovery is 88 % from the nearly zero after tsunami. Yet, the recovery rate of agriculture is only 40%, fishery is 69% and the recovery rat of marine products industry is also as low as 55%. Tourism industry is gradually recovering, while the it was still at the level of 85% at the end of 2011.

As for employment, the offers-seekers ratio of the three prefectures seriously damaged by 311 Earthquake is over the national average reflecting the the increase of jobs related to reconstruction. Yet, there is a mismatch of job offers-seekers. The job offers to skilled workers in the construction sector are more than job seekers while jobs rather fit to female seekers such as clerks or food processing industry are not enough.

Recovery from the Damages Caused by Nuclear Power Plants Accident

The problems caused by the accident of the nuclear power plant in Fukushima Prefecture are totally different from the areas damaged by tsunami. The total number of evacuators of the Fukushima Prefecture is as many as 160,000, about half of the total evacuators including those evacuated because of tsunami. Among them, evacuators to outside the Fukushima Prefecture reach 59,000. A large areas are designated as the areas to be evacuated because of high level of radiation of 20 km radius and up to 40 km range in the case of northwest sector (Fig. 6).

Source: Ministry of Economy, Trade and Industry

Fig. 6 Evacuation Areas due to the Fukushima Nuclear Power Plant Accident

Reconstruction Plan

After the 3.11 Earthquake almost all the municipalities have formulated city-level master plan within one year and they are currently formulating more

detailed plans for specific areas. In some areas, detailed plans are also decided and moving towards implementation phase. Reconstruction projects proposed by the Reconstruction plan are submitted to the Reconstruction Agency for assessment and upon the approval by the Reconstruction Agency, the grants are provided to the local government for implementation. Since the Reconstruction Agency designated 40 projects such as relocation projects, projects proposed by local governments should be in line with those 40 designated projects.

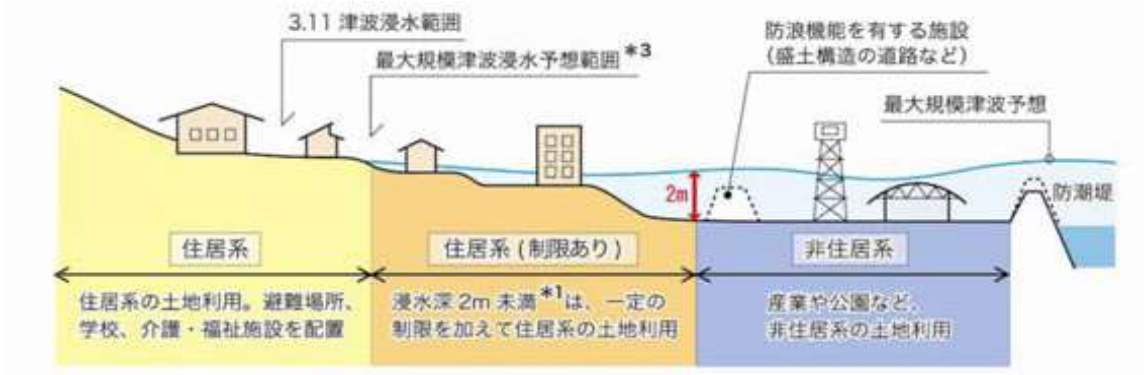
The city-level master plans are based on the concept: the construction of 'Level 1' seawall, relocation, designation of non-residential areas, second line embankment by using roads on mount, raising of ground level of residential areas by land readjustment (Fig. 9 - 11):

(1) So called 'Level 1' tsunami, which may occur once around 100 years, should be protected by planned seawalls (mostly higher than 10 m; in some places, even higher than 15 m).

(2) If 'Level 2' tsunami occurs, which is the largest possible size similar to 3.11 tsunami, it is expected that those planned seawalls are overcome thus the areas where simulated depth of inundation by tsunami is more than 2m is designated as disaster vulnerable areas based on the Building Standard Law and residential use is prohibited, since the ratio of collapse of buildings critically decreased in 3.11 tsunami, if the inundation level is less than 2 m.

(3) Those areas designated as non-residential are to be relocated or to raise ground levels so that inundation level becomes less than 2 m.

(4) In the case such as plain land where over 2 m inundation areas become large according to simulation, second protection line is constructed by using roads on mount as embankment and the land suitable for residential purposes is enlarged.

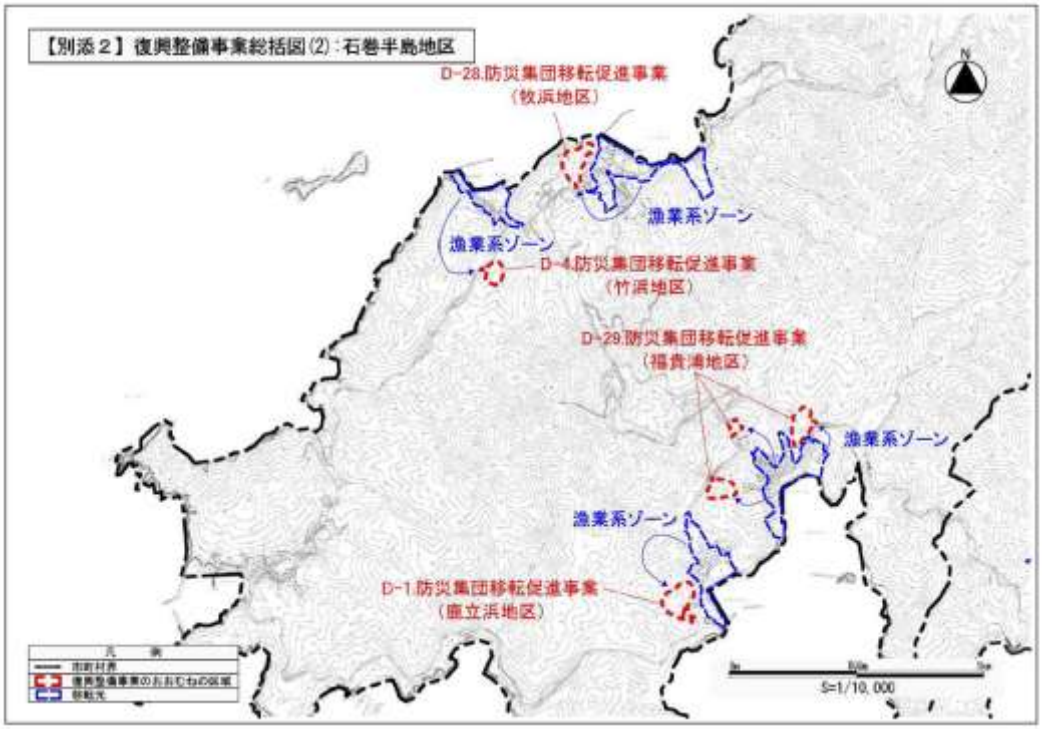


Source: Ministry of Land, Infrastructure and Transportation

Fig 9 Concept of Reconstruction Master Plan

Source: Ishinomaki City

Fig. 10 Example of Reconstruction Concept: City center area of Ishinomaki City



Source: Ishinomaki City

Fig. 10 Example of Reconstruction Concept: Fishery villages of Ishinomaki City

Reconstruction of Settlements

Under the Special Act for The Reconstruction of Built-up Areas damaged by Natural Disaster (1995), within the designated Reconstruction Promotion Area all the developments are controlled by building permission. All the cities and towns have already formulated general reconstruction plans and designated Reconstruction Promotion areas if needed. In those areas as many as 276 areas are planned to be relocated under the Disaster Prevention Settlements Relocation Program, which promotes the relocation of settlements from the areas damaged by and vulnerable to tsunami to the appropriate areas on the hillside. National subsidy is utilized for site development, infrastructure development and the purchase of original plots by the local governments. Residents should pay for land and housing construction at the relocated areas, though original land plots are purchased by local governments and supports to purchase of land and housing construction is available. Land readjustment projects which reorganize the settlements by raising ground level is planned in 58 areas (Fig. 7 & 8). In addition, about 20,000 units of public housing is planned to be constructed.

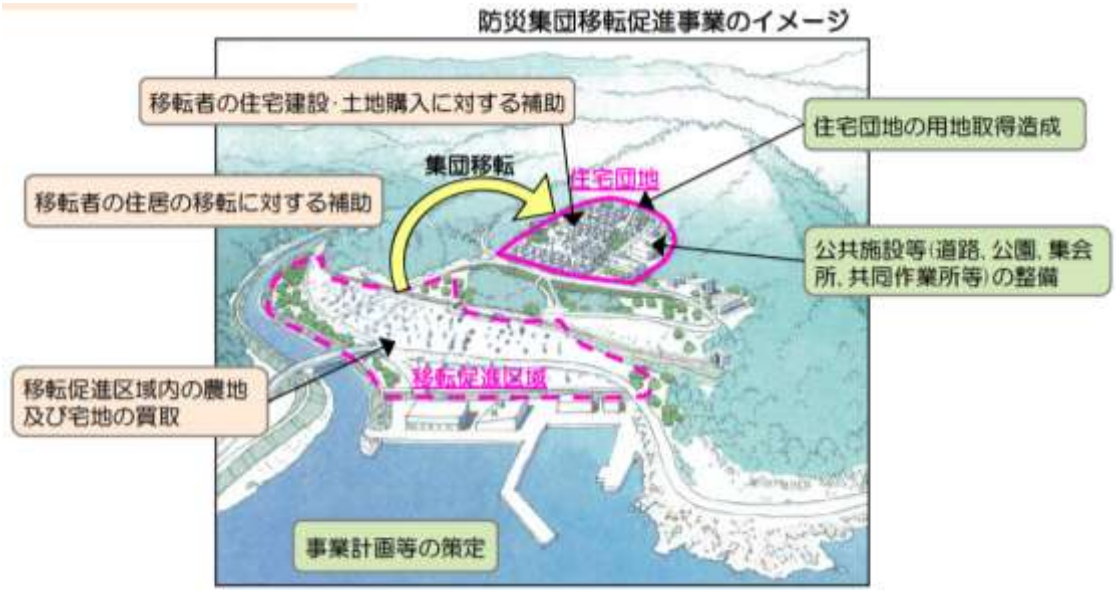


Fig. 7 Disaster Prevention Settlements Relocation Program

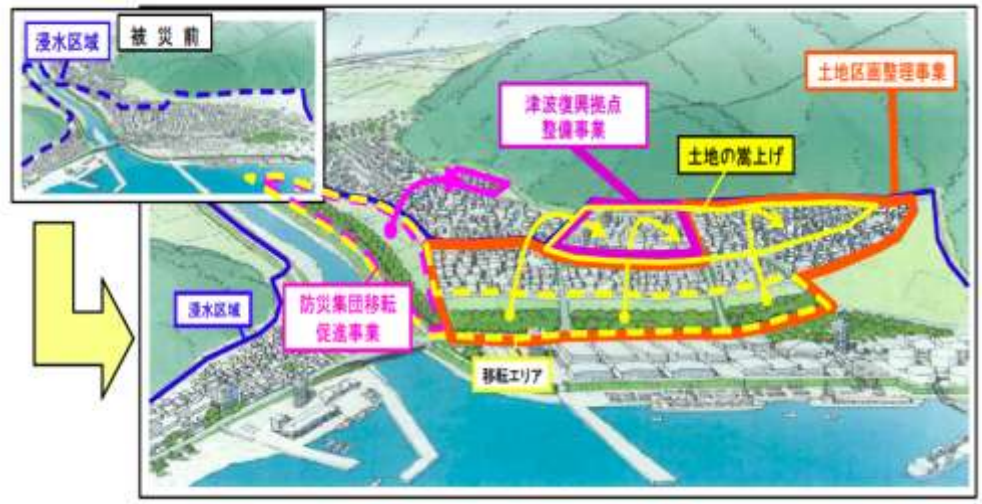


Fig. 8 Reorganization and Raising the Ground Levels of Settlements through Land Readjustment Project

DISCUSSIONS

Problems of Large-scale Infrastructure-based Reconstruction

The precondition of the present Reconstruction plans is the construction of costly large-scale seawalls. First, cities are built not only on the basis of safety. Increasing the height of seawalls will increase the level of safety from tsunami, yet, it will destroy the continuity of the land and the sea, which may affect tourism industry to a large extent. Second, the low-land coastal areas designated as non-residential areas are planned to be marine product industry areas, parks, tourism commercial areas. Yet, there are many questions such as: whether there really exists the demand for industrial use, who bear the costs of construction and maintenance of parks, etc.

Third, there is a fundamental question that the decline of newly reconstructed areas might start right after the completion of completion, since population is decreasing and the rate of aged people is quite high in these areas. In these conditions, it is doubtful that costly reconstruction is justified. Though there is no clear answer to these questions yet, it is quite a big issue to be considered since a large amount of costs is required for building large-scale infrastructure.

Lack of a Long-term, Region-wide Vision

The basic concept of present reconstruction plans is based on the Business as Usual (BAU) scenario that the damaged areas should be reconstructed to come back to the original situation. Yet, as mentioned before, the damaged areas had started to decline since before. Thus, even though the reconstruction is completed, it will not solve fundamental problems of those areas, or may even worsen the problems by using limited fund to costly and useless structures rather than utilizing those funds to critical issues and loose the chance to alleviate fundamental problems. Against this background, there should a need of alternative scenario based on a long-term, region-side vision which can propose a new direction of sustainable development. A new direction should be a scenario based on the symbiosis with the nature, if we consider the potential cultural and natural resources in the damaged areas. The business as usual scenario assume that the attraction of industry, manufacturing industry, in particular, is the key of development under dogmatic national development concept, but the scenario based on the symbiosis with the nature should be the one to attract people who feel sympathy with the life-culture as well as the nature of the region and provide the opportunity for those attracted to the region to realize their own values and start business (Fig. 9).

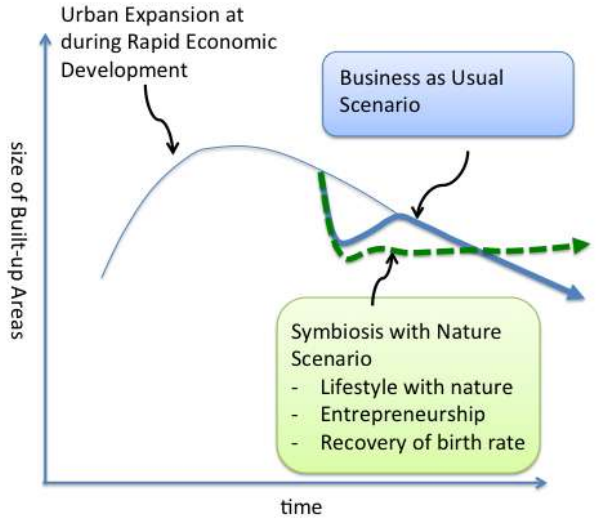


Fig. 9 Alternative Scenario for Reconstruction

CONCLUSION – TOWARDS A RESILIENT AND SUSTAINABLE REGION

The Asian region is exposed to high level of natural hazard risks, which is quite a different condition of European countries from where modern urban and regional planning ideas originated (Fig. 10). In this sense, it can be said that modern urban and regional planning ideas which have been adapted by the world does not seriously consider frequent natural hazard risks such as earthquake, tropical storms. If it is so, we need to reconsider the fundamental conditions of urban and regional planning so that regions become more resilient. The whole which is composed of functionally isolated units is vulnerable once each unit is seriously damaged. Thus, the basic principle of resilience will be: 1) each unit possesses rather high level of mixed functions, 2) those units are networked in multiple ways. For example, though it is an afterthought, it may be pointed out that the design of newly developed areas along the coast, which were seriously damaged by 3.11 tsunami, is often devoted to maximize the efficiency of the single-function such as residential or industrial and did not seriously consider other functions such as the way to live along the natural risks.

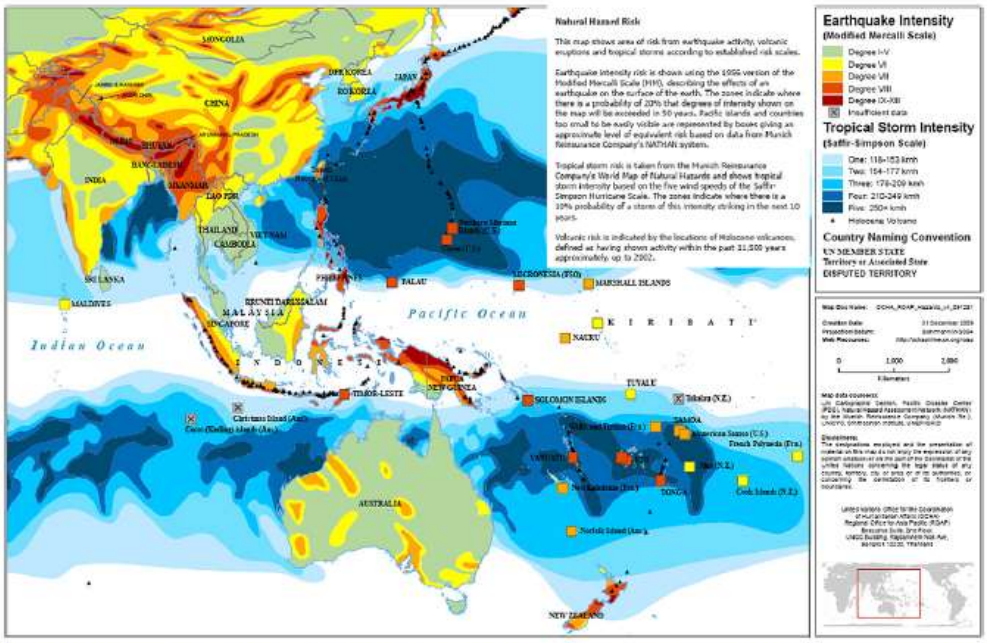


Fig. 7. East Asia hazard map (from United Nations Office for the Coordination of Humanitarian Affairs, Regional Office for Asia and the Pacific (OCHA ROAP)).

Fig.10 East Asia Hazard Map (Source: Hochrainer & Mechler (2011))

As mentioned before, the region damaged by 3.11 tsunami have long been experiencing the decline of population as well as hyper aged society as in other remote rural areas of Japan. 3.11 tsunami disaster will further worsen the situation. In this sense, the way to reconstruct this region after 3.11 tsunami would be a model for other areas to revitalize. When the resilience issues mentioned above area considered, the preconditions of national spatial policy should be changed from efficiency-based, conventional hierarchy (tree) structure to the self-reliant yet networked at the multi-scale, regional and national structure (Fig. 11). This structural change is required not only from resilience, but also from economic and social aspects. Under globalization, the shift from mass production-based investment-oriented economy to knowledge-based economy becomes increasingly important. The keyword of the former is 'efficiency' but the one of the latter is 'creativity'. Hierarchy structure, which often force people to follow standardized, dogmatic ideas, will not be suitable to creative society. Flexible, multi-scale networked society should be, apparently more suitable to enhance the creativity of the people.

As Japanese society has been largely changed through the reconstruction after the Hanshin-Awaji Earthquake in 1995 to the emphasis on the role of civil society and *machizukuri*, we hope that Japanese society would be changed to more sustainable society through the reconstruction after 3.11 tsunami disaster and the accidents of nuclear power plant.

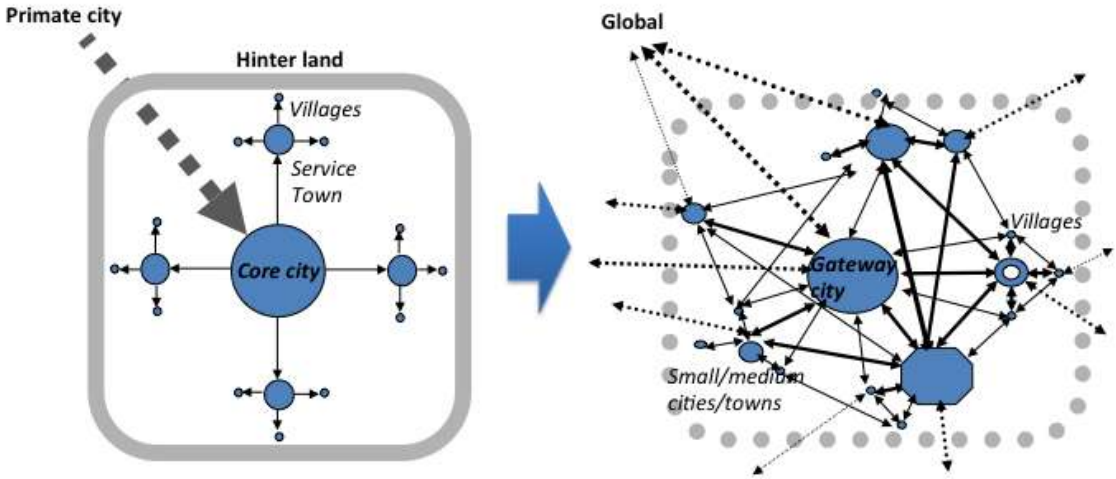


Fig. 11 Change of the National and Regional Structure from Hierarchical Structure to Multi-scale Network

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