A comparative study of the European and Japanese definitions of shrinking cities as applied to Japan

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Abstract

Population decline and industrial decline are obvious phenomena not only in Europe but also in Japan. Issues related to population and industrial decline have been actively discussed, and academic knowledge and analysis based on international comparative studies are expected to develop countermeasures to the most critical situations.

The definition of shrinking city that is applied, however, is not necessarily the same, and such a fundamental element of the discussion has not been fully examined so far.

This study, therefore, aims at comparing the different definitions of "shrinking cities" used in Japan and Europe and developing the best way to provide a reliable basis for future discussion on shrinking cities' topics.

The results of this comparative study suggest that COST Action's definition allows an analysis of Japanese cities to include the so-called "depopulated area issue" because the Japanese population in municipalities is rather bigger than the population in European municipalities, and Japanese cities may have lower figures for population density distribution and artificial land use within their territory.

In conclusion, Japanese sampled cities based on the Japanese definition are not necessarily suitable for the basis of a comparison study. This is because some Japanese "cities" do not satisfy objective criteria such as population size because the "city" has never been downgraded having once been upgraded to "city". Rather, the European definition of "city" better reflects the elements of the city, so that Japan should also follow the European definition of "city" for future discussions on shrinking cities.

1. Introduction

1.1. Background

In Japan where nationwide population decline started, not only rural depopulation but also urban depopulation has now become obvious. Population decline in cities and industrial decline has been studied in the context of "shrinking cities". The 5W1H of shrinking cities and countermeasures for it have been discussed in many previous research studies around the world. In this context, the definition of "city" used is not necessarily the same in different regions and countries.

For example, there are quite different local government systems and regional structures. These differences do not allow us to compare the problems of shrinking cities easily. To cope with this situation, a common definition of the "city" was provided in COST Action[1]. Based on this definition, shrinking cities were identified and the demographic change of the cities was analyzed (Wiechmann and Wolff, 2013).

Many case studies of shrinking cities in Europe have already been introduced in Japan. For example, there are the German shrinking cities cases (Uemura and Uto, 2010), the case of Berlin and Brandenburg (Takami and Harada, 2009), the case of French vacant house countermeasures (Koyanagi, 2014) and the Torino regrowth case in Italy (Yahagi, 2014).

When we compare the best practice for regional development around the world, we should bear in mind the premise of the case, such as the attributes of the region. In a discussion of shrinking cities, we should bear in mind the definition of "city" and "urban". Unfortunately, the difference in the definition of the city in Japan and the city in the context of the shrinking cities in Europe is still not clear.

From now on, to promote an international comparison study between shrinking cities in Japan and other countries, it is important to clarify the differences in the definition of the city in Japan and in Europe in the context of shrinking cities, and also to evaluate the impact of these differences on the discussion.

1.2. Aim

In order to clarify the differences between cities in Japan and Europe and also to evaluate the impacts of this difference, the definition of "city" used in the COST Action Programme in Europe is applied to the Japanese municipalities' attribute data, and then the Japanese municipalities are categorized. By using the definition of the "city" used by COST Action, we can identify the reasons for the differences between Japan and Europe. Accordingly, this study aims to also examine the causes for the differences. In addition, the definition of demographic change used by COST Action is also applied to the demographic change of

[1] http://www.cost.eu/COST_Actions

shrinking municipalities in Japan. This study also examines the geographical distribution of cities according to each categorization.

1.3. Structure

In section two, the methodology including research steps, the introduction of the definition of "city" and demographic change, and data set are introduced. In the third section, the results of the application of the definition to Japan are presented. In section four, the validity of the definition of Japanese "city" and the geographical distribution of categorized "shrinking cities in Japan" are examined. Also, the reason for the variance between Japanese "cities" and European "cities" is discussed. Finally, the summary is presented and further research topics are also indicated in the concluding section.

2. Methodology

2.1. Research framework

This study follows the three steps below.

First, this study examines the validity of the definition of "city" in Japan by applying the European definition used by COST Action to Japanese municipalities' data and the results are plotted on a map of Japan, and the coverage of classified municipalities are confirmed.

Second, the demographic change of Japanese shrinking cities is analysed based on the European definition of dynamic typology used by COST Action and then the results are drawn on the map of Japan.

Third, a comparison between Japanese cities and "cities" categorized by the European definition is conducted. The number and ratio of Japanese cities according to the Japanese definition but not cities according to the European definition, and cities following the European definition but not cities according to the Japanese definition against the total number of municipalities in Japan are also confirmed. Moreover, the causes of such a mismatch are also discussed.

Through these three steps, the possibility of the application of the European definition of "cities" used by COST Action is examined.

2.2. Definition

2.2.1. Definition of "city"

Under the COST Action definition, "cities" are defined by three criteria, "size of population", "population density", and "artificial land use" as shown in Table 1. Hereafter, municipalities classified by these criteria are called "Cities by European definition" to be identified from "Cities by Japanese definition".

Table 1 Three criteria for defining cities by COST Action

Items	Criteria
Population size	Total population in 2010 in the municipality > 5,000 inhabitants
Population density	Density of the population living in densely populated parts of more than 1,000 inhabitants per km^2 > 50%
Artificial land use	Share of urban area (artificial surface) within the municipality > 5%

Source: Wiechmann and Wolff (2013)

2.2.2. Definition of dynamic typology

In order to describe the demographic change in shrinking cities in Japan, three types of shrinkage of the demography in the region are defined in COST Action: "continuous shrinkage", "episodic shrinkage" and "temporary shrinkage".
The same definitions of dynamic typology as used in COST Action are applied. In COST Action, the data between 1990 and 2010 are used for the analysis. This period may be identified by the reunion of Eastern and Western Germany in 1989, the democratization of the former communist countries of Eastern Europe in the 1990s and the enlargement of the European Union that occurred in the early 2000s. This time, the same definition should be used to confirm the validation of the definition by COST Action for Japan. The date between 1990 and 2010, therefore, is used for the analysis.

Table 2 Dynamic Typology in COST Action

Dynamic typology	COST Action
Type A Continuous shrinkage	These cities have lost at least 0.15% of their residents annually in all four five-year intervals since 1990.
Type B Episodic shrinkage	These cities have lost in at least one five-year period a stable (+/- 0.15% p.a.) or even growing population (> +0.15% p.a.).
Type C Temporarily shrinking cities	These cities have not lost population of at least 0.15% p.a. over the entire period, but have in at least one five-year period.

Source: Wiechmann and Wolff (2013)

2.3. Data

The data for analysis are the "population" and "area" of municipalities, and land use information in a 100m × 100m grid of "Land utilization segmented grid data".
The 500m ×500m grid population data is used for the Population density criterion. The population in 500m ×500m divided by 2.5 is equal to population density (people/km^2) in the grid. The ratio of grids satisfying the criterion for population density against all grids within the municipality is calculated, and the result is used for classification.
For classification of artificial land use, the 100m × 100m grid of "Land utilization segmented grid data" is used. "Site of building", "trunk transport site" and "other site" are regarded as artificial land use in the data set. By counting grids used for these land uses, and by comparing the number of grids against all grids belonging to the municipalities, the

percentage of artificial land use area in the municipalities is calculated. Based on the percentage, the municipalities are classified.

Table 3 Data for analysis and data source

Criteria	Data name	Data source
Population size	Population in 2010	Statistics Bureau (2012) POPULATION AND HOUSEHOLDS OF JAPAN 2010
Population density	Population in 500m × 500m grid	
Artificial land use	Land usage classifications	National Land Numerical Information, Land utilization segmented grid data

3. Results

3.1. Result of city classification by COST Action criteria and dynamic typology

3.1.1. Size of population

The result of applying the population size criterion is that more than 85% of municipalities in Japan have achieved this criterion. The distribution of municipalities on the map suggests that municipalities located in almost all regions except the northern part of Hokkaido and mountainous areas of Honshu, Shikoku and Kyusyu could meet these criteria. Accordingly, it is suggested that the size of municipalities in Japan is rather larger than that in Europe.

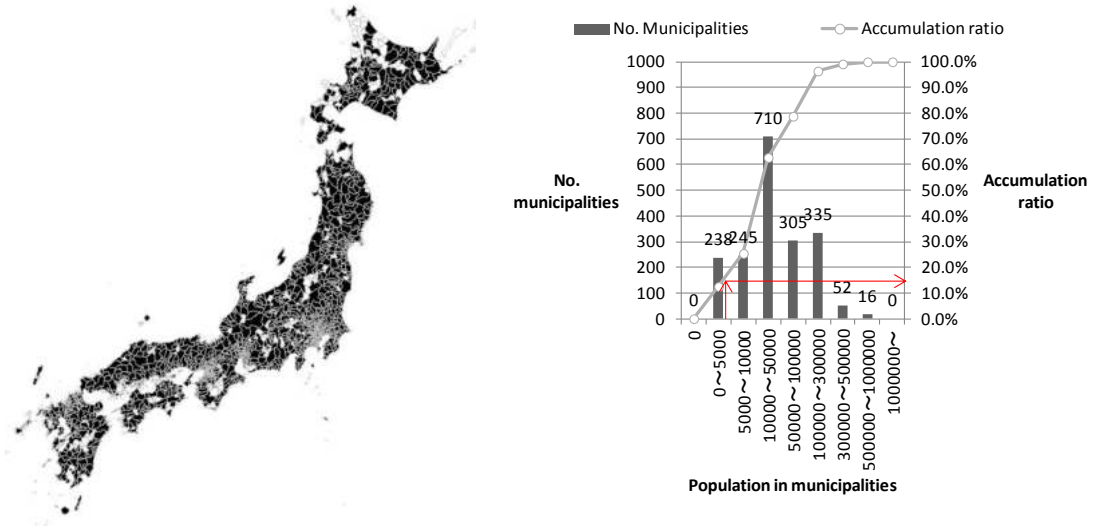


Figure 1 Municipalities with more than 5,000 people

3.1.2. Density of population

In terms of the population density criterion, more than 60% of municipalities in Japan could meet the criteria of more than 50% of the population living in densely populated areas (1,000 people/km^2). Interestingly, when we confirm the distribution of these selected municipalities on the map of Japan, most areas of Hokkaido, the urban areas in Honshu, and coastal areas of

Honshu, Chugoku and Kyushu regions as well as a part of Shikoku are identified. The possible reason for this result may be due to the limited inhabitable areas as mountains and rivers are common in Japan. So that even if the municipalities have a lower population, it is natural that most of the residents in the municipalities tend to concentrate in the inhabitable areas. On the other hand, where municipalities meet the criteria for "city" in population size and are located on plain areas, the population is sometimes scattered throughout the area of the municipality. In this case, consequently, the municipality cannot meet the population density criterion.

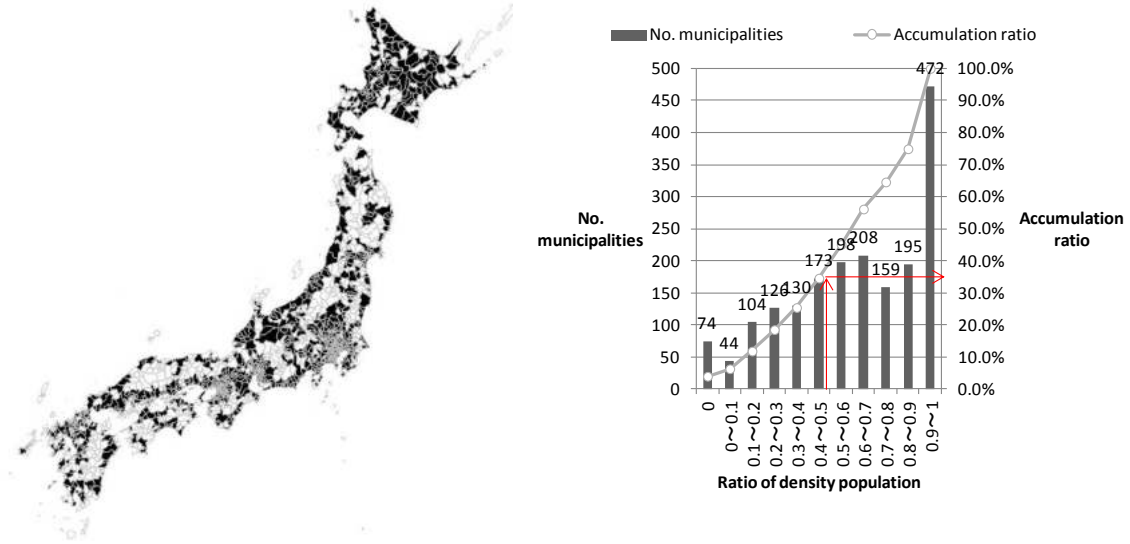


Figure 2 Municipalities with more than 50% population living in densely populated area (1,000 population/km^2) in the municipality

3.1.3. Artificial land use

On the condition of artificial land use, more than 60% of municipalities in Japan could satisfy this criterion. When the municipalities meeting this criterion were projected on the map, we found that only urban areas were identified. This is because urban municipalities tend to meet the criterion easily, but the area of municipalities in rural areas is typically larger than the area of urban municipalities, explaining why rural municipalities were not identified as meeting the land-use criterion.

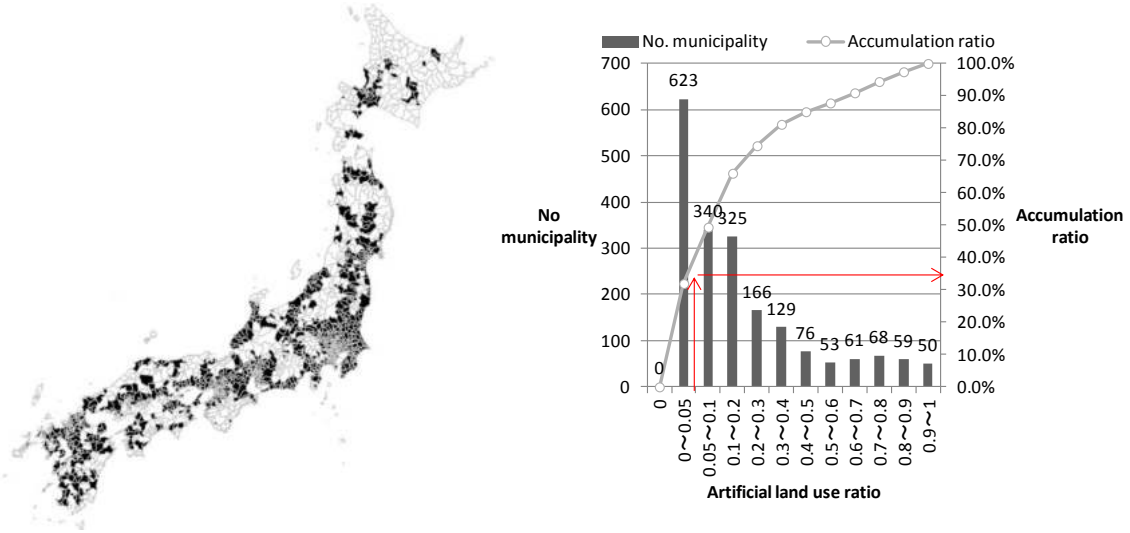


Figure 3 Municipalities with more than 5% artificial land use compared with all municipality areas

3.1.4. Results of the classification of municipalities

Consequently, 987 municipalities out of 1,856 municipalities in Japan are identified as "cities by European definition". The ratio of "cities by European definition" is around 53.2% of total municipalities in 2010.

Table 4 Results of the classification of municipalities by applying the definition of the city in COST Action

Number	Continuous shrinkage	Episodic shrinkage	Temporary shrinkage	No shrinkage	subtotal	Total
Not "City"	580	180	82	27	869	
City	142	148	293	404	987	
Sub total	721	325	374	436		
Total						1856

Proportion by the city category	Continuous shrinkage	Episodic shrinkage	Temporary shrinkage	No shrinkage
Not "City"	80.4%	55.4%	21.9%	6.2%
City	19.7%	45.5%	78.3%	92.7%
Total	100.0%	100.0%	100.0%	100.0%

Proportion by shrinking pattern	Continuous shrinkage	Episodic shrinkage	Temporary shrinkage	No shrinkage	subtotal	Total
Not "City"	66.7%	20.7%	9.4%	3.1%	100.0%	
City	14.4%	15.0%	29.7%	40.9%	100.0%	

When we conduct further analysis on the demographic change between 1990 and 2010 in these municipalities, 14.4% of Japanese cities (European definition) are classified as "continuous shrinkage", 15.0% of them are classified as "episodic shrinkage", 29.7% of them are classified as "temporary shrinkage" and the remaining 40.9% of cities are classified as "no shrinkage". On the other hand, 66.7% of non-city Japanese municipalities are classified

as “continuous shrinkage”, 20.7% of them are classified as “episodic shrinkage”, 9.4% of them are classified as “temporary shrinkage”. Only 3.1% of non-city Japanese municipalities (European definition) are classified as “no shrinkage”.

3.2. Demographic change pattern of Japanese cities (European definition)

Next, the distribution of municipalities classified as Japanese cities according to the European definition is projected onto the map of Japan. The Japanese cities (European definition) classified as “continuous shrinkage” are located mainly in Hokkaido, coastal areas of the Japan-sea region, the western Chugoku region and Kyushu. In particular, the top 10 continuously shrinking cities in Japan are Amagasaki (Hyogo), Nagasaki (Nagasaki), Shimonoseki (Yamaguchi), Hakodate (Hokkaido), Kure (Hiroshima), Hitachi (Ibaragi), Kushiro (Hokkaido), Suma ward of the city of Kobe (Hyogo), Imabari (Ehime), and Ishinomaki (Miyagi). They are commuter towns in the Kansai district and the prefectural capital cities or second or third largest cities in the prefectures.

Japanese cities (European definition) classified as “temporary shrinkage” are mainly located in not only three major urban areas in Japan namely Tokyo, Osaka and Nagoya, but prefectural capitals as well, for example, Setagaya (Tokyo), Ota (Tokyo), Adachi (Tokyo), Suginami (Tokyo), Itabashi (Tokyo), Higashi-Osaka (Osaka), Nishinomiya (Hyogo), Kouto (Tokyo), Gifu (Gifu) and Nagano (Nagano). Twenty-three cities in the Tokyo metropolitan areas and Osaka suburb cities such as Higashi-Osaka, Nishinomiya and Neyagawa are influenced by the trend of inner migration to the city centre following outer-migration from the city centre to the suburbs.

The areas classified as “episodic shrinkage” seem to be located between “continuously shrinking” areas and “temporarily shrinking” areas. The population decline has halted at least once, but overall the areas have lost population over 20 years. The prefectural capitals more than urban areas and regional centres are regarded as “episodic shrinkage”.

Furthermore, the distribution pattern for these three types of Japanese cities (European definition) in the three major urban areas such as Kanto (Tokyo), Kinki (Osaka) and Chubu (Nagoya) is completely different. In Kanto, most of the 23 cities of the Tokyo metropolitan area are classified as “temporary shrinkage”, but the suburb areas surrounding the 23 cities of the Tokyo metropolitan area are not classified as any of the three dynamic typologies. Of course, the northern Kanto, Kamakura and southern part of the Boso Peninsula have faced shrinkage as well as most of the 23 cities of the Tokyo metropolitan area. On the other hand, the centre of Osaka cities faces “continuous shrinkage”. On the map, we can see the red marking in the central areas of Osaka. In addition, there are many temporary shrinkage areas in the suburbs of Osaka. Some municipalities next to these shrinking municipalities also face “episodic shrinkage”. In general, most municipalities in the Kinki urban areas seem to be more or less suffering from population decline.

In contrast to these two urban areas, only central Nagoya city areas show shrinkage. Apart from limited municipalities, almost no Japanese cities (European definition) are classified as shrinking areas. For reference, when we turn to the Fukuoka urban areas, the shrinkage in the suburbs is more severe than the other three urban areas, but the city centre of Fukuoka still maintains its population and is not classified as having any shrinking dynamic typology.

Table 5 Top 10 municipalities in three demographic change patterns

	Continuous shrinkage		**Episodic shrinkage**		**Temporary shrinkage**	
	Municipality, Prefecture	Population in 2010	Municipality, Prefecture	Population in 2010	Municipality, Prefecture	Population in 2010
1	Amagasaki, Hyogo	453,748	Yokosuka, Kanagawa	418,325	Setagaya, Tokyo	877,138
2	Nagasaki, Nagasaki	443,766	Toyonaka, Osaka	389,341	Ota, Tokyo	693,373
3	Shimonoseki, Yamaguchi	280,947	Wakayama, Wakayama	370,364	Adachi, Tokyo	683,426
4	Hakodate, Hokkaido	279,127	Asahikawa, Hokkaido	347,095	Suginami, Tokyo	549,569
5	Kure, Hiroshima	239,973	Iwaki, Fukushima	342,249	Itabashi, Tokyo	535,824
6	Hitachi, Ibaragi	193,129	Kita, Tokyo	335,544	Higashi Osaka, Osaka	509,533
7	Kushiro, Hokkaido	181,169	Sasebo, Nagasaki	261,101	Nishinomiya, Hyogo	482,640
8	Suma, Kobe, Hyogo	167,475	Neyagawa, Osaka	238,204	Kouto, Tokyo	460,819
9	Imabari, Ehime	166,532	Hachinohe, Aomori	237,615	Gifu, Gifu	413,136
10	Ishinomaki, Miyagi	160,826	Tarumi, Kobe, Hyogo	220,411	Nagano, Nagano	381,511

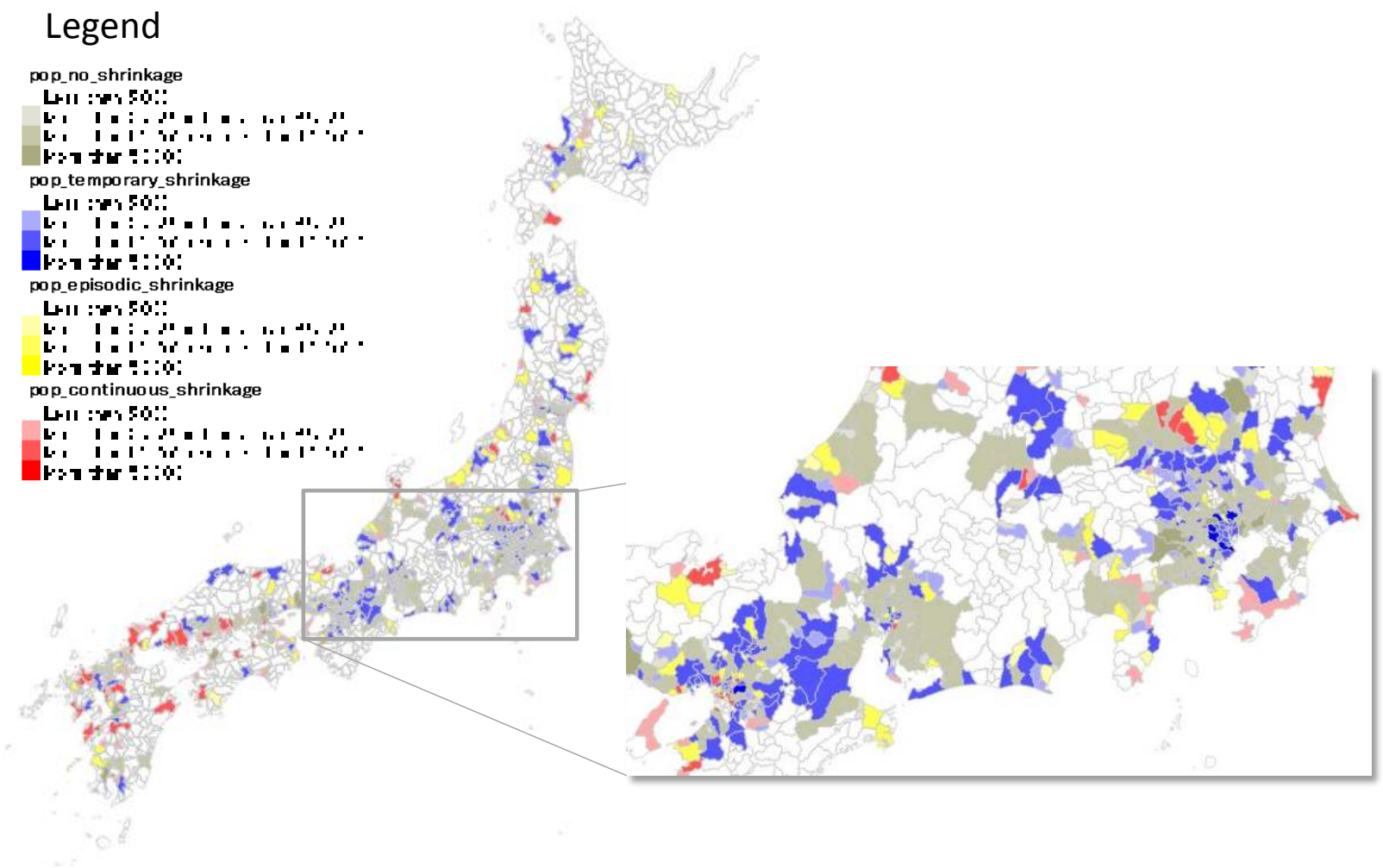


Figure 4 Dynamic typology results following the definition of COST Action

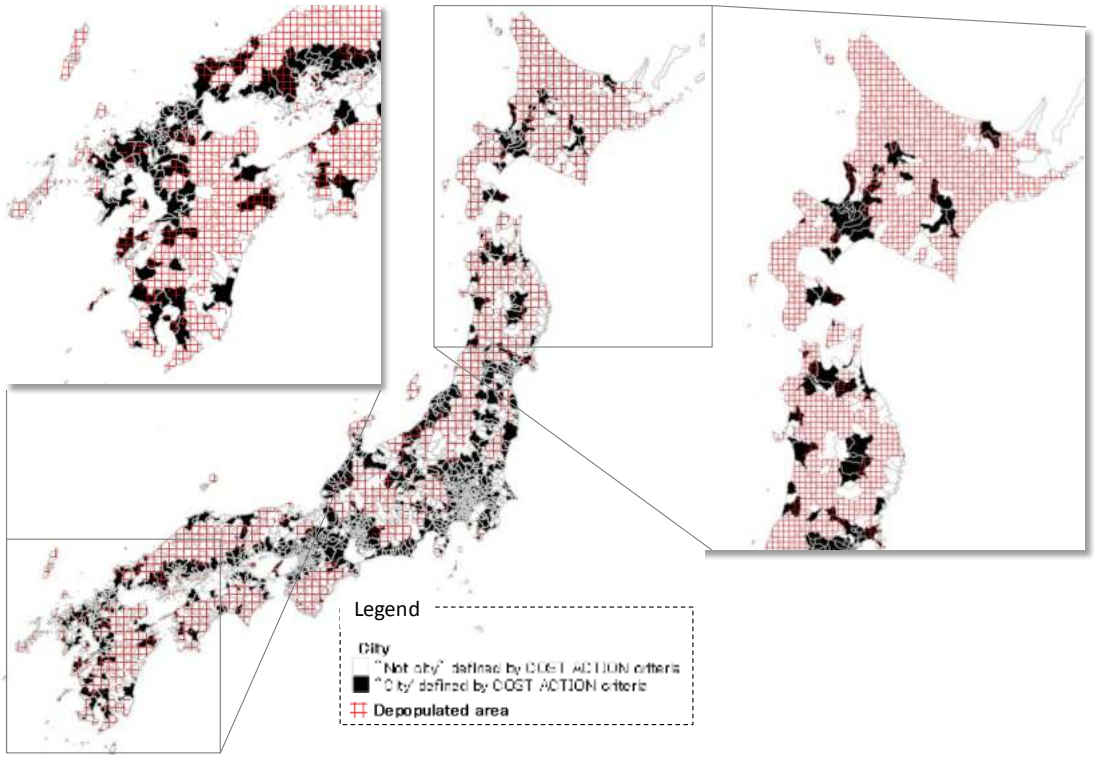
4. Discussion and analysis

This section mainly discusses the validity of the definition of the "city" by COST Action.

4.1. City as defined by COST Action criteria in Japan

Figure 5 shows the Japanese cities (European definition) and depopulated areas on the map of Japan. The municipalities in urban areas are naturally selected as "Japanese cities (European definition)" but some municipalities in Hokkaido, Kyushu, Shikoku are also selected as "Japanese cities (European definition)".

Interestingly, some cities in Hokkaido and Kyushu are typically hatched both black and also red grid. Red grid means that the municipalities belong to traditional "depopulated areas" in rural areas as determined by the Act on special measures for the promotion of independence for underpopulated areas (enacted on 31st March, 2000). Accordingly, it is very difficult to regard them as shrinking cities. In short, these are examples of the error by which municipalities that should not be defined as shrinking cities are selected as "Japanese cities (European definition)".



Source: The data for "depopulated area" is from National Land Numerical Information, Underpopulated Area Data

Figure 5 Cities in Japan based on the definition of COST Action and depopulated areas

4.2. Comparison of the definition of "city" between Japan and the Europe

Next, the opposite case is discussed. Namely, Japanese cities as defined in Japanese legislation are not necessarily selected as Japanese cities (European definition).

Basically, Japan has two layers of local autonomy system, namely prefectures and city-town-village. The following Table 6 shows the cross tabulation of population size and classification of "city" and "others" including town and village.

Table 6 Situation for meeting the criterion for "city in Japanese legislation"

	2005		2010	
	Population of less than 50,000	Population of more than 50,000	Population of less than 50,000	Population of more than 50,000
City	259	712	265	706
Others	928	2	928	2

Generally in Japan, cities according to Japanese legislation subsume urban areas, and towns and villages are typically located in rural areas. In fact, cities in Japanese legislation are distinguished from towns and villages by the objective criteria as shown in Table 7, when the municipalities are upgraded to cities in Japanese legislation. It should be noted that once upgraded, the city will not be downgraded to town or village as long as can be anticipated. Consequently, sometimes the local situation and the classification of municipalities do not match completely.

As shown in Table 7, which compares the definition of cities by COST Action and Japanese legislation, the definition of cities is, actually, similar, but different. In particular, the population size criteria differ, and the Japanese population size criterion is 10 times greater than that of COST Action.

Table 7 Definitions of "city" by COST Action, Japanese legislation and this study

Criteria	COST Action	This study	Japanese legislation (Article 8, Local Autonomy Act)
Population size	Total population in 2010 in the municipality > 5,000 inhabitants	Total population in 2010 in the municipality > 5,000 inhabitants	In principle, a municipality with more than 50,000 people
Population density	Density of the population living in densely populated parts with more than 1,000 inhabitants per km^2 > 50%	More than 50% population living in the 500m × 500m grid areas with more than 250 people in the municipality	More than 60% of households located in densely populated area, and more than 60% of population engaged in urban occupation like commerce and industry
Artificial land use	Share of urban area (artificial land use) within the municipality > 5%	The number of grids with mainly artificial land use like multistorey buildings (0701),factories (0702), lower buildings (0703), densely located lower buildings (0704), road (0901), railway (0902), public facilities (1001), vacant area (1002), park and green spaces (1003) and golf courses (1600) in 500 m square areas is more than 5% of the total number of grids in the municipality	—
Others	—	—	Other necessary conditions in each prefecture

In terms of population density, the description is slightly different, so that we cannot compare them completely, but it suggests that the European criteria require more than 50% concentration, but Japanese criteria require more than 60% concentration of population in the densely inhabited areas. Accordingly, the European criteria may be more relaxed than the Japanese criteria.

Furthermore, the artificial land use criterion is not included in the Japanese criteria.

According to these different criteria to select "cities", the cities in Japanese legislation, which do not meet the definition of Japanese cities (European definition) number 199 cities (26.0% of all cities in Japanese legislation). Within these 199 cities, 137 cities in Japanese legislation do not satisfy the population size criterion of having more than 50,000 people. Out of 137, only one city in Japanese legislation does not satisfy the European criterion of population size of more than 5,000 people. Also, 87 cities in Japanese legislation do not satisfy the artificial land use criterion in Europe and 94 cities in Japanese legislation do not satisfy the population density criterion in the European definition.

Table 8. Reasons why 199 cities according to Japanese legislation are not classified as "Japanese cities (European definition)"

	Population size (population<5,000 people)	Artificial land use criterion (Ratio of artificial land use is more than 5%)	Population density criterion (Densely populated area should be more than 50% of municipality land)
Reasons for not meeting the classification as a "city"	1	127	124
（incl. No. of municipalities with less than 50,000 population）	1	87	94

The major reasons why cities in Japanese legislation are not classified as Japanese cities (European definition) are not meeting the artificial land use criterion and population density criterion. This suggests that even if the municipalities are regarded as cities in Japanese legislation, dense inhabitation is not met and population is scattered throughout the municipality.

Table 9 shows the results of the classification of municipalities in Japan based on the Japanese and European criteria.

Table 9 Results of the classification of municipalities in Japan based on Japanese and European criteria

<table>
<tr><td colspan="3" rowspan="2">N=1,856
(Municipalities)</td><td colspan="2">European definition</td></tr>
<tr><td>City</td><td>Others</td></tr>
<tr><td rowspan="3">Japanese definition</td><td colspan="2">City</td><td>567</td><td>199</td></tr>
<tr><td colspan="2">Others</td><td>367</td><td rowspan="2">670</td></tr>
<tr><td></td><td>Depopulated region</td><td>53</td></tr>
</table>

The situation is very complicated, but it can be said that the criteria used in COST Action could produce a completely different list of shrinking cities in Japan. The difference amounts to 26% between Japanese cities as defined in Japanese legislation and the common set between Japanese and European criteria (567 municipalities).

When the Japanese definition is applied, and researchers intend to include the Japanese cities in Japanese legislation as much as possible, the artificial land use criterion and population density criterion should be relaxed. Given that the objective criterion of population size for upgrading to "Japanese cities in legislation" is, however, not necessarily observed, it can be said that it is not appropriate to meet the Japanese criteria. In this regard, the European criteria in COST Action for identifying "cities" in Japan in order to discuss shrinking cities issues can be regarded as a more appropriate way to give the common basis for future international comparative study.

5. Concluding remarks

This study examined the validity of the definition of cities used by COST Action to discuss shrinking cities issues in Japan using data from Japan.

As a result, the "Japanese cities in Japanese legislation" and "Japanese cities (European definition)" are not the same, and two types of variance could be observed; namely, Japanese cities in Japanese legislation that were NOT Japanese cities (European definition), and Japanese cities (European definition) that were NOT Japanese cities in Japanese legislation.

One of the reasons for this situation may be that the criterion of population size has not been strictly applied for municipalities upgrading to "Cities in Japanese legislation", and some municipalities with less than 50,000 people have still been defined as "Cities in Japanese legislation". In addition, there is no criterion on artificial land use for defining "cities" in Japan. Accordingly, when we define cities around the world in order to conduct an international comparative study, it can be concluded that the Japanese criteria are not appropriate. In other words, the criteria to select cities used by COST Action should be applied to Japan to provide a good foundation for future international comparative studies.

The COST Action definition, however, also has a weak point. Bearing in mind that the cause of weakness of the Japanese criteria is the failure to strictly implement the criteria, the same can be said for the COST Action definition. This is because the COST Action definition of cities was introduced in 2013 and has not stood the test of time. In 5 years and 10 years time, researchers will update the analysis in Europe based on the COST Action definition of cities; some of the cities selected in 2010 will not be selected at that time. The situation is continuously changing and any definition will receive the evaluation of time.

In order to allow continuous research based on the same definition, researchers have to develop a more concrete and reliable definition of cities and objective rules for selecting cities to facilitate the discussion of shrinking cities. This point is still open to discussion.

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