

Chapter 2

Japanese Basic Landscape Types, and Change in Population and Urban Land Use

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Abstract This chapter illustrates typical landscape types extracted by principal component analysis and cluster analysis. It also discusses the distribution patterns and characteristics of these landscape types and examines the relationship between land use and population changes. The following seven landscape types were extracted: urban landscape, urban paddy field mixed landscape, paddy field landscape, other field landscape, paddy field satoyama landscape, other field satoyama landscape, and nature landscape. Then, through the combination analysis of land use and population changes in recent years, shrinking, compacting, stability, scattering, and expanding tendencies are observed. Not only in Nagoya but also in the periphery of the Tokyo Metropolitan Area, a mosaicked structure of the above tendencies was clearly observed, with satoyama landscape types most dramatically confronting the crisis of disappearance.

Keywords Population · Land use · Change · Landscapes type · Population estimation

2.1 Overview of Japanese Landscapes and Land Use

Japan is an elongated island nation, where a steep sloped mountainous area is spreading as a backbone in the center. Figure 2.1 shows the land use of the national land in 2009. These mountainous areas are covered mostly by forest and created a forest landscape (Fig. 2.2). Even though steep sloped mountainous areas cover the main parts of Japanese lands, there are some flat plains which were made by the

The original version of this chapter was revised: In Fig. 2.49 caption: 1975 was changed to 2005. The erratum to this chapter is available at [10.1007/978-981-10-2278-4_26](https://doi.org/10.1007/978-981-10-2278-4_26)

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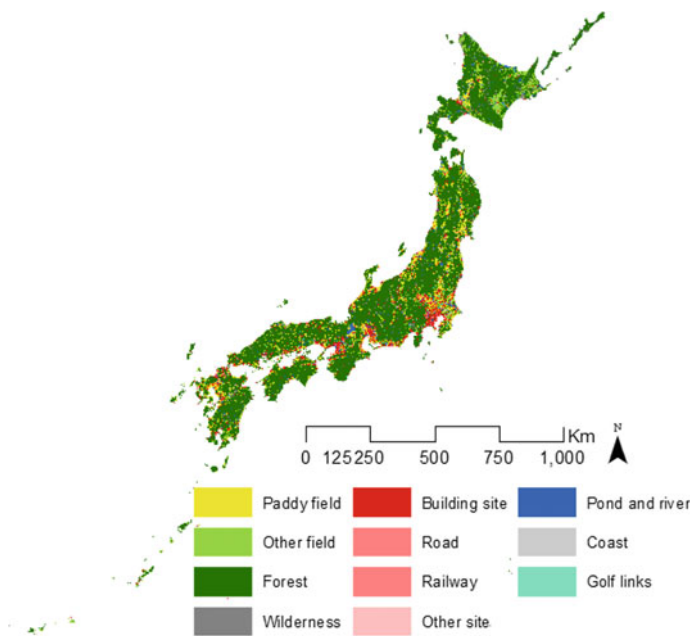


Fig. 2.1 Land use of the national land in 2009



Fig. 2.2 Forest landscape in a mountainous area



Fig. 2.3 Northern edge of Nobi Plain

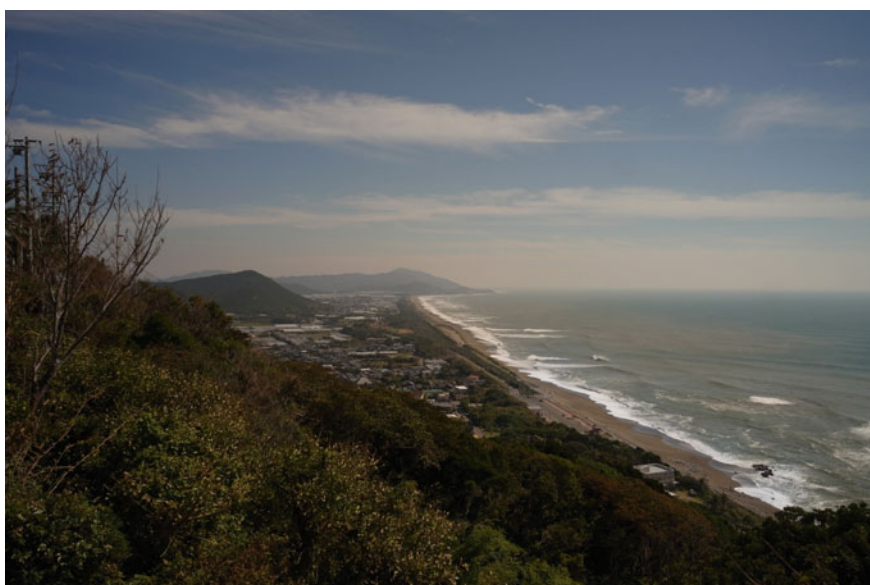


Fig. 2.4 Small plain in Chita peninsula



Fig. 2.5 Farmland landscape in Toyama Prefecture



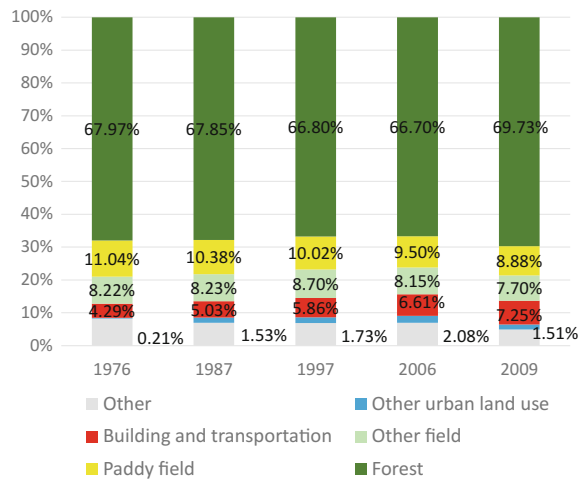
Fig. 2.6 Urban-farmland mixed landscape



Fig. 2.7 Satoyama landscape

marine transgression in the ancient age. These plains are highly cultivated and most of Japanese population is living there. Figure 2.3 shows an edge of urban area to a forest area. High densely populated urbanized areas, i.e. urban landscapes, are spreading up to mountainous areas. Even in a small plain among hills, high densely cultivated countrysides are spreading everywhere (Fig. 2.4). Farmland landscapes are also spread in flatlands (Fig. 2.5). In big plains with big cities like Tokyo, Osaka or Nagoya, endless urban sprawls with fields, houses and factories, are remarkable. This can be termed an urban-farmland mixed landscape (Fig. 2.6). This mixed landscape is one of the typical landscapes of Japan. In relatively gentle sloped

Fig. 2.8 Land use change between 1976 and 2009



mountainous areas there are many small villages with fields and secondary forests, which consist of Japanese typical landscapes, Satoyama landscapes (Fig. 2.7).

Figure 2.8 shows land use change between 1976 and 2009. Forests cover constantly over 66 % of the total national land. The significant land use change occurs between farmlands and urban land uses. Farmlands decrease constantly and changed to urban land uses. These changes occur mainly in flatlands. As a result, urban-farmland mixed landscapes are spreading.

2.2 Extract of Japanese Basic Landscape Types and Characteristics

This section shows typical landscape types extracted by principal component analysis and cluster analysis, and distribution patterns and characteristics of them. The land use data in 1 km meshes in 2009 (*National Land Numerical Information, Land utilization tertiary mesh Data*) provided by the National Land Numerical Information Download Service (National Land Information Division, National Spatial Planning and Regional Policy Bureau, MILT of Japan 2009) is used for the analysis.

As a preparation for the analysis, Normalized Difference Index (NDI) between different land uses are prepared. NDI is defined as follows:

- A as an area ratio of a certain land use in a certain mesh
- B as an area ratio of another land use in a same mesh

$$NDI = (B - A) / (A + B)$$

Forest and urban land use NDI, forest and total field NDI, total field and urban land use NDI and paddy field and other field NDI are prepared. A principle component analysis is carried out by using variables of forest ratio, total field ratio, urban land use ratio, forest and urban land use NDI, forest and total field NDI, total field and urban land use NDI and paddy field and other field NDI. Table 2.1 shows correlations and significant probabilities of variables. Significant probabilities of all the variables are significant at the 1 % level, and three factors shown in Table 2.2 are extracted.

According to the results of the principle component analysis, a cluster analysis is carried on, and the seven basic landscape types are extracted, namely paddy field type, urban paddy field mixed type, paddy field Satoyama type, other field type, urban type, other field Satoyama type and nature type. Table 2.3 shows seven basic landscape types extracted by the cluster analysis. Table 2.4 shows the percentages of seven basic landscape types throughout Japan. Figure 2.9 shows the spatial distribution of the seven basic landscape types.

Areas of the paddy field Satoyama and other field Satoyama types, which correspond to Satoyama landscapes, account for 28.4 %, but the population in them is only 5.9 %. On the contrary, areas of the urban type account for only 5.7 %, but the

Table 2.1 Correlations and significant probabilities of variables

Correlation										
	Foratio09	Ubratio09	Firatio09	FoFiNDI09	FoUbNDI09	FiUbNDI09	PaOfNDI09			
	Foratio09	1.00	-0.63	-0.73	0.90	0.85	-0.03			
	Ubratio09	-0.63	1.00	0.10	-0.42	-0.80	-0.50			
	Firatio09	-0.73	0.10	1.00	-0.88	-0.48	0.48			
	FoFiNDI09	0.90	-0.42	-0.88	1.00	0.76	-0.25			
	FoUbNDI09	0.85	-0.80	-0.48	0.76	1.00	0.25			
	FiUbNDI09	-0.03	-0.50	0.48	-0.25	0.25	1.00			
	PaOfNDI09	-0.04	0.07	0.01	-0.06	-0.15	-0.04			
	Foratio09		0.000	0.000	0.000	0.000	0.000			
Significance probability	Ubratio09	0.000		0.000	0.000	0.000	0.000			
	Firatio09	0.000	0.000		0.000	0.000	0.000			
	FoFiNDI09	0.000	0.000	0.000		0.000	0.000			
	FoUbNDI09	0.000	0.000	0.000	0.000		0.000			
	FiUbNDI09	0.000	0.000	0.000	0.000	0.000				
	PaOfNDI09	0.000	0.000	0.000	0.000	0.000	0.000			
	Foratio09	0.000	0.000	0.000	0.000	0.000	0.000			
	Ubratio09	0.000	0.000	0.000	0.000	0.000	0.000			

Table 2.2 Three factors extracted by principle component analysis

Component matrix after rotation	Component		
	Forest-non forest	Non urban-urban	Paddy field-other field
Foratio09	0.942	0.237	−0.000
Ubratio09	−0.478	−0.812	0.029
Firatio09	−0.888	0.368	−0.004
FoFiNDI09	0.979	−0.027	−0.029
FoUbNDI09	0.792	0.537	−0.120
FiUbNDI09	−0.259	0.894	−0.016
PaOfNDI09	−0.030	−0.032	0.999

Table 2.3 Seven basic landscape types extracted by cluster analysis

Cluster centers	Clusters						
	Paddy field satoyama type	Paddy field type	Other field satoyama type	Urban type	Nature type	Urban paddy field mixed type	Other field type
Forest-non forest	0.168	−1.936	0.084	−0.787	0.727	−1.222	−1.574
Non urban-urban	0.667	0.519	0.587	−2.742	−0.135	−1.721	0.895
Paddy field-other field	1.322	1.120	−1.417	−0.741	−0.026	1.131	−1.411

population of them reaches to 54.8 %. Areas of the urban paddy field mixed type, where urban land uses and paddy field land uses are mixed, are only 4.2 %, but the population accounts for 24.0 %. Therefore, 79 % of the Japanese population lives in the urban paddy field mixed and urban types, with an area size of less than 9.9 % of all of Japan.

Table 2.4 Percentages of seven basic landscape types in all of Japan

Landscape types	Mesh number	Mesh number ratio (%)	Population	Population ratio (%)
Paddy field satoyama type	59,411	15.7	46,312,131	3.6
Paddy field type	30,039	7.9	11,332,782	8.9
Other field satoyama type	47,903	12.7	2,884,748	2.3
Urban type	21,462	5.7	70,094,360	54.8
Nature type	174,449	46.1	3,231,294	2.5
Urban paddy field mixed type	15,760	4.2	30,658,752	24.0
Other field type	29,522	7.8	5,139,252	4.0
Sum	378,546	100.0	12,792,419	100.0

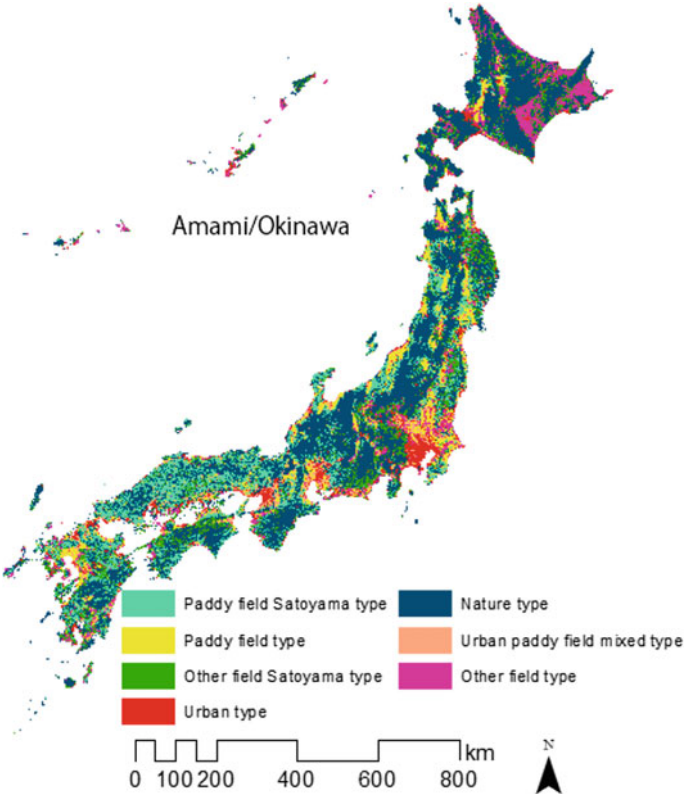


Fig. 2.9 Spatial distribution of seven basic landscape types

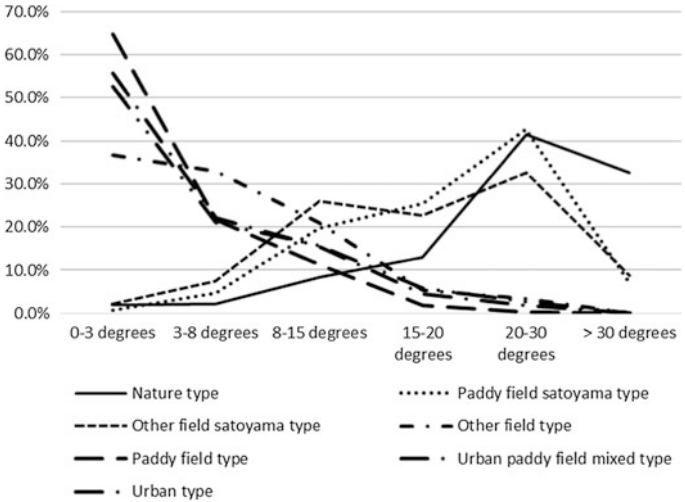


Fig. 2.10 Seven basic landscape types and land gradients

Figure 2.10 shows the relation of these seven basic landscape types and average land gradients of meshes. Specialization of the paddy field, urban paddy field mixed and urban types to the areas of the flat or gentle sloped areas of average land gradients between 0° and 15° is remarkable. Other field type shows the same tendency, but it spreads much more in sloped areas.

On the contrary, the distribution of the paddy field Satoyama and other field Satoyama types shifts to the area of average land gradients between 8° and 30° . Also, specialization of the nature type to the areas of average land gradients over 20° is remarkable.

2.3 Distribution of Japanese Basic Landscape Types in Wide Regions

Figure 2.11 shows the distribution of landscape types in Hokkaido in a subarctic zone. Landscapes, especially in the eastern part, are very similar to Central Europe with hilly farmlands, where large-scale crops cultivations have been developed.

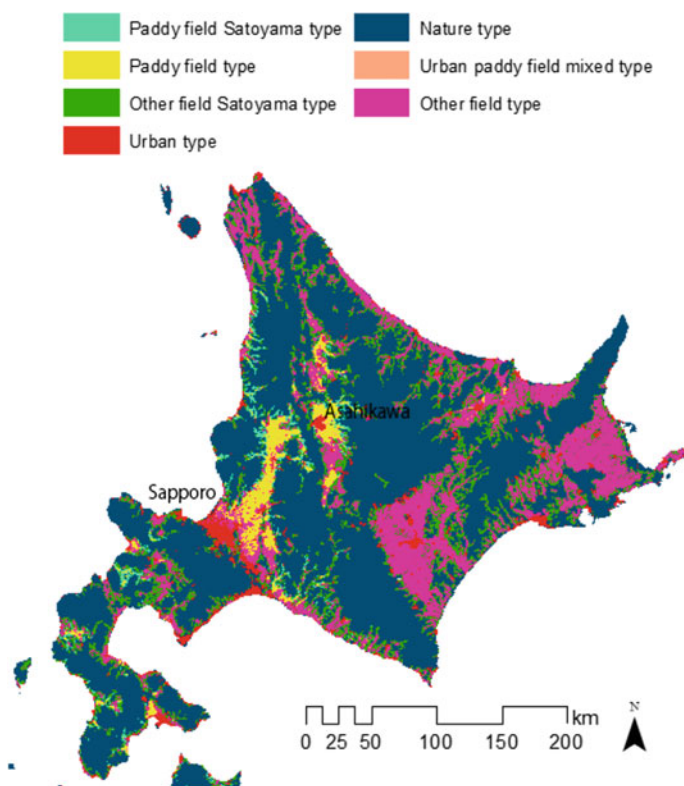


Fig. 2.11 Basic landscape types in Hokkaido

Most population is agglomerated in Sapporo, a prefectural capital. In the northeast part of Sapporo, the paddy field type is spreading widely, where good quality rice is cultivated.

Figure 2.12 shows the landscape types in the Tohoku, Kanto, Hokuriku and Tokai wide regions. The Tohoku and Hokuriku wide regions are the most important producing areas of rice, especially in the Shinano River basin in the southern part of Niigata and in the Kitakami River basin in the northern part of Sendai, where the

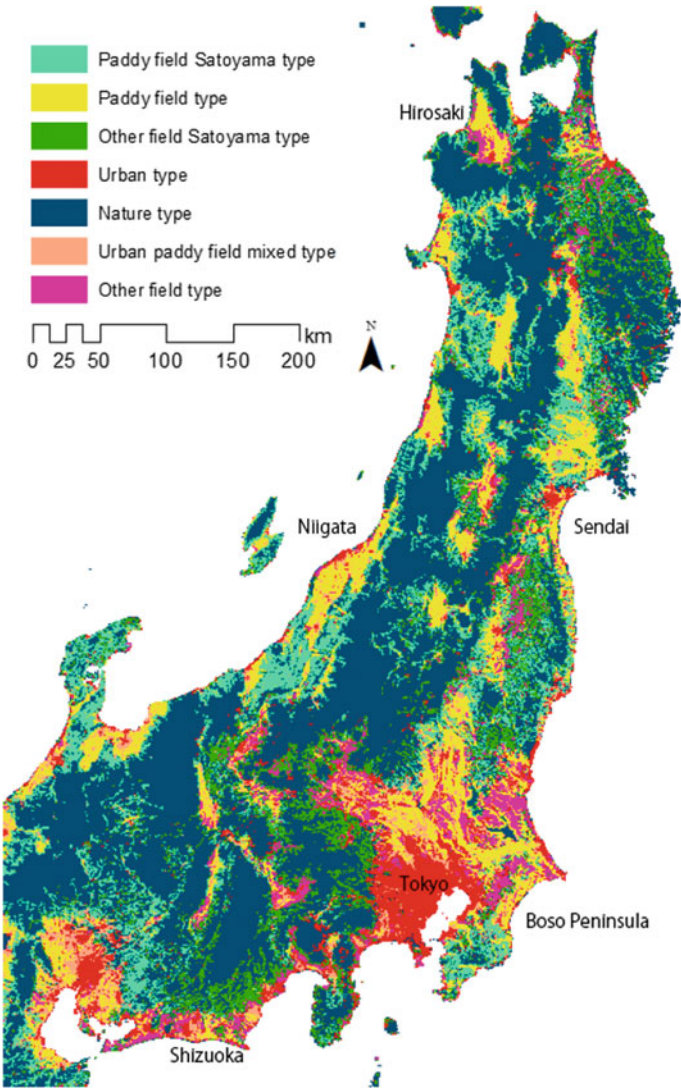


Fig. 2.12 Basic landscape types in Tohoku, Kanto, Hokuriku and Tokai wide regions

paddy field and paddy field Satoyama types are spreading. The urban type is spreading in and around Tokyo widely. In the northern part of Tokyo, the Tone River flows from west to east, along which the paddy field type is spreading in low lands. In plateaus of the northern part of the Boso Peninsula, the other field type is spreading. In the north western part of Tokyo, between Tokyo and Nagano, which is a relatively cool highland, the typical other field type is widely spreading. These are very important districts of vegetable and fruit production. In the plateaus of Shizuoka mandarin orange tree and tea plantations are spreading widely, which create a special other field type.

Figure 2.13 shows the landscape types in Kansai, Shikoku, Chugoku and Kyushu wide regions. A very big Median Tectonic Line is crossing these wide regions from Kumamoto, Matsuyama to Wakayama. It is very interesting to know that there is a big difference in landscape types between the northern and southern parts of the line. In the southern part of the line, the nature and other field Satoyama types are spreading widely; on the contrary, in the northern part the paddy field Satoyama and paddy field types are spreading dominantly. The southern part of Wakayama and the western end of Shikoku are very famous mandarin orange

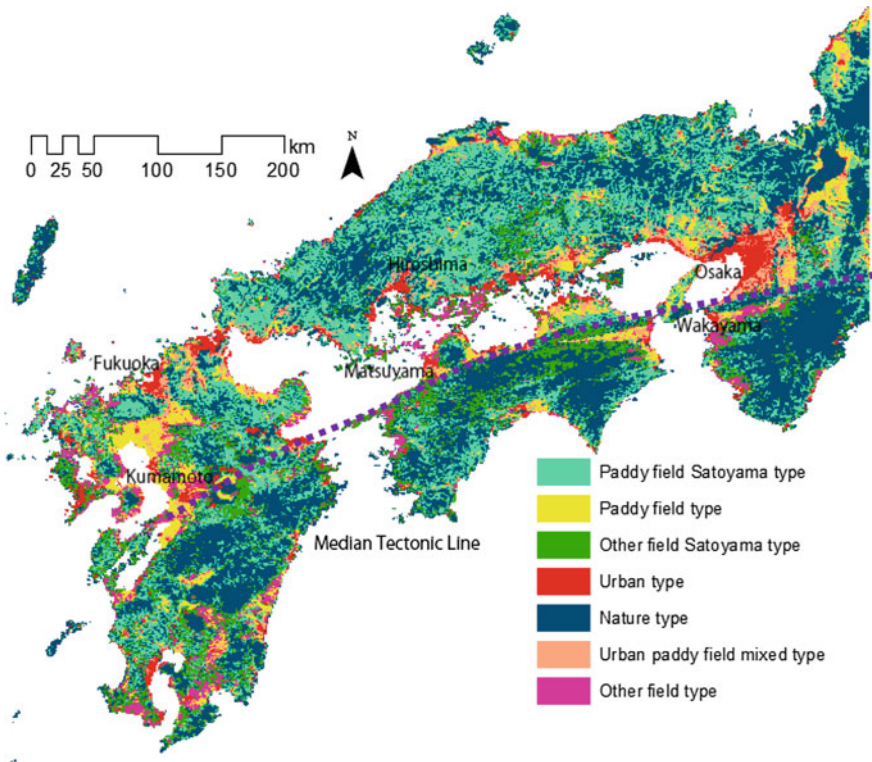


Fig. 2.13 Basic landscape types in Kansai, Shikoku, Chugoku and Kyushu wide regions

plantation districts and create the typical other field type. It is also characteristic that the paddy field Satoyama type is spreading widely in the mountainous area in the Chugoku wide region.

Figure 2.14 shows the detailed distribution pattern of 7 landscape types around the area of Ise Bay, where Nagoya is located in the center. In the southeastern part and in the western part of Nagoya, the urban paddy field mixed and urban types are widely spreading and are mixed with the paddy field type. Nagoya and the surrounding districts are one of the most developed industry areas and a strong agglomeration of population and urban expansions are observed. Matsusaka, located in the western coast of Ise Bay, is a relative small regional city but historically very famous and has a wide area which consists of all types of landscapes.

As described above, Japan is not homogeneous country in its landscapes. There are characteristic regional differences. Especially Satoyama landscapes occupy 28 % of Japanese land and consists an important basic landscape, but the population is only less than 6 %. On the contrary in the urban and urban paddy field

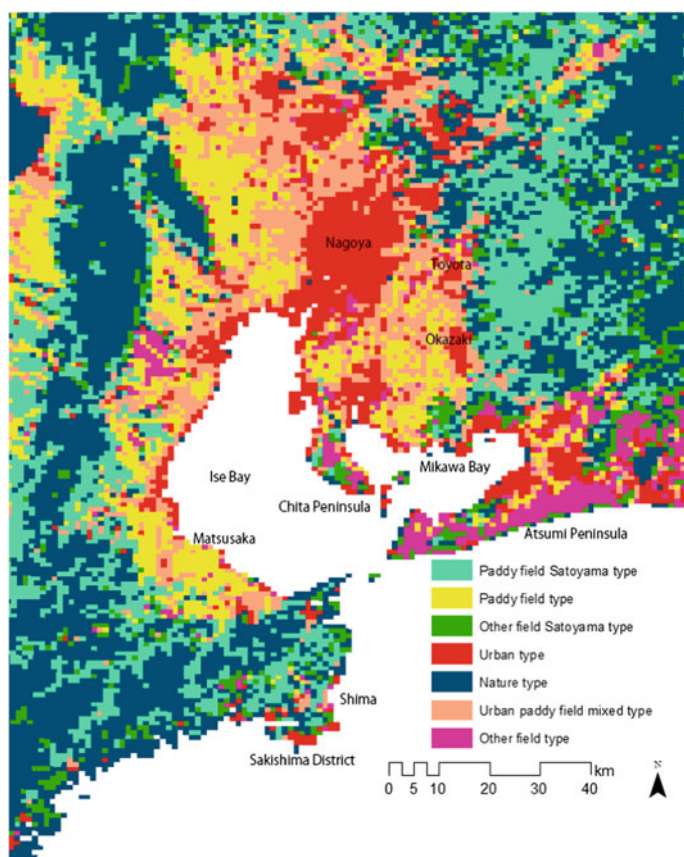


Fig. 2.14 Basic landscape around Ise Bay area

mixed types, which occupy only 10 % of the national land, lives 79 % of the population. This might be a reason that there is less public attention to the situation of Satoyama landscapes.

2.4 Overview of Changes in Population, Urban Land Use

Expansion of urban land use has affected the wide range of ecological systems. Urban landscape changes might be related to population changes. This section shows the characteristics of spatial distribution patterns and their change of urban land use and population throughout the national land of Japan by using 1 km mesh analysis on GIS. The data employed are from the Statistics Bureau of the Ministry of Internal Affairs and Communication (E-Stat 2015), and the University of Tokyo (CSIS 2015).

Japan consists mostly of steeply sloped mountainous areas in the center (Fig. 2.15). There are, however, some flat diluvial plains where most of the population is agglomerated. Big cities such as Tokyo/Yokohama, Osaka, Nagoya and so on are located in such plains (Fig. 2.16).

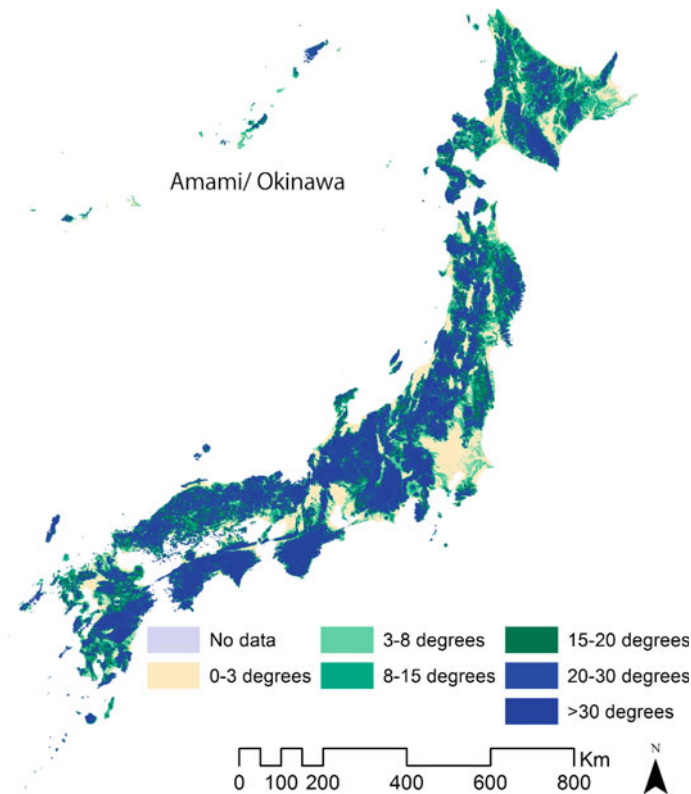


Fig. 2.15 Average land gradients in 1 km meshes

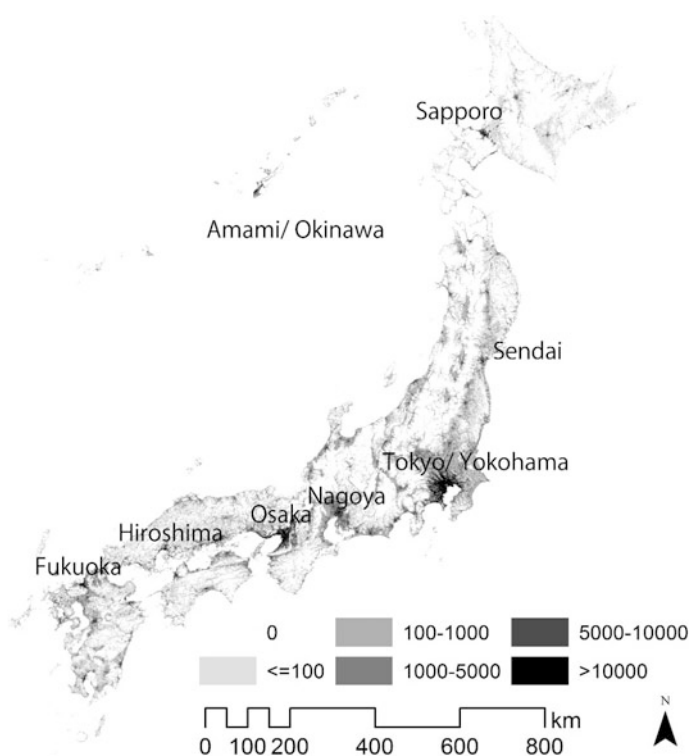


Fig. 2.16 Population distribution in 2010

Japan is now in the phase of population shrinking which began in 2008. Figure 2.17 shows the population changes between 1975 and 2010. The threshold between decrease or increase and being stable is $\pm 5\%$ change. Although the distribution pattern shows an increasing trend as a whole, there are many areas with a shrinking population in the countryside. Figure 2.18 shows the recent population changes between 2005 and 2010. The threshold is set to $1/7$ of the threshold of the change between 1975 and 2010 in correspondence with the period length. It is obvious that the areas of population decrease expand widely in the countryside, although there is a tendency toward increasing population in densely populated urban areas of big cities, such as Tokyo, Osaka and Nagoya and so on.

Figure 2.19 shows the relation of the population changes between 1975 and 2010, and the land gradients. It is obvious that the population increase occurs in the relative flat areas under 8° . But it can't be ignored that the population decrease already occurs in all categories of land gradient ranks. Figure 2.20 shows the relation of the recent population changes between 2005 and 2010, and land gradients. It is remarkable that decreasing and increasing trends are reversed from the change between 1975 and 2010 in their ratios and the decreasing trend becomes dominant.

Fig. 2.17 Population changes between 1975 and 2010 (Threshold 5 %)

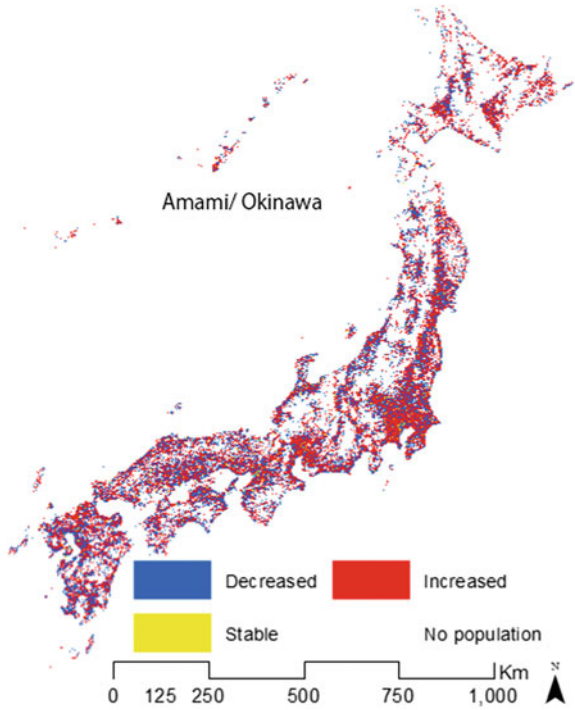
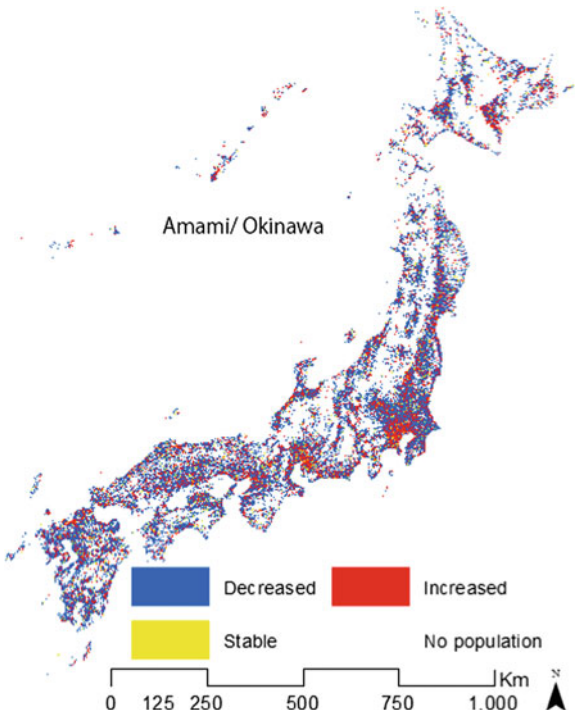


Fig. 2.18 Population changes between 2005 and 2010 (Threshold 0.7 %)



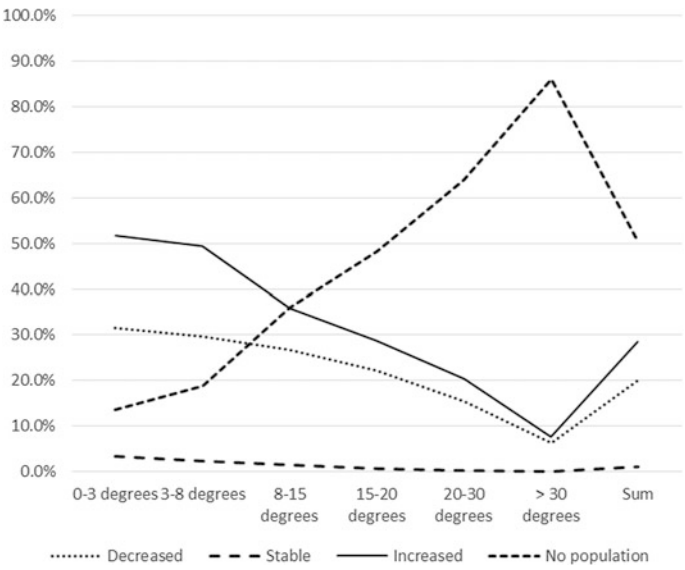


Fig. 2.19 Population changes between 1975 and 2010 and land gradients (Threshold 5 %)

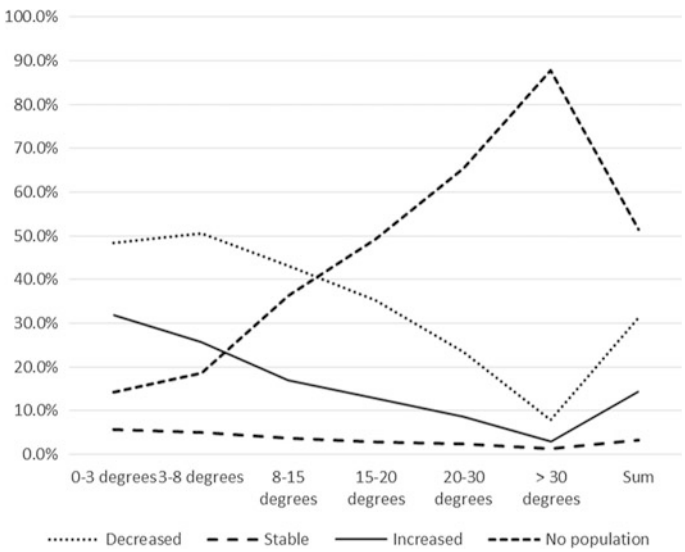


Fig. 2.20 Population between 2005 and 2010 changes and land gradients (Threshold 0.7 %)

Figure 2.21 shows the urban land use changes between 1976 and 2009. The threshold between decrease or increase and being stable is $\pm 5\%$ change. High urban land use increases can be observed in the densely populated areas, such as Tokyo, Nagoya, Osaka and so on. But the decrease in urban land use is already

Fig. 2.21 Urban land use changes between 1976 and 2009 (Threshold 5 %)

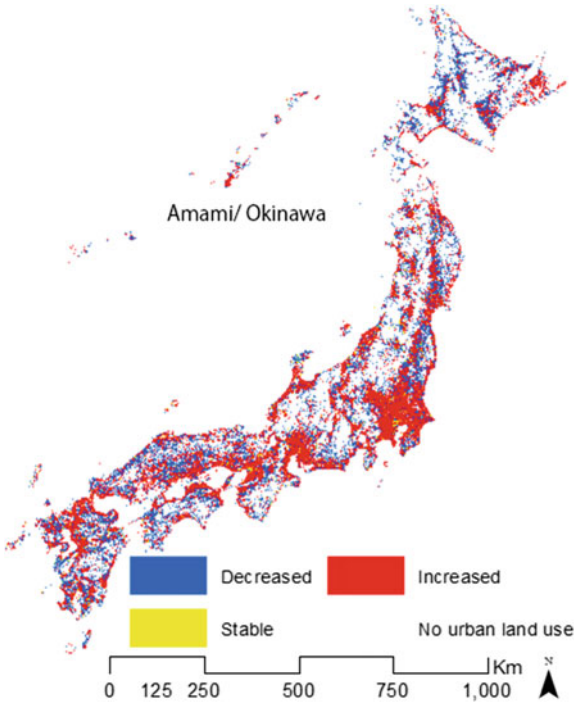
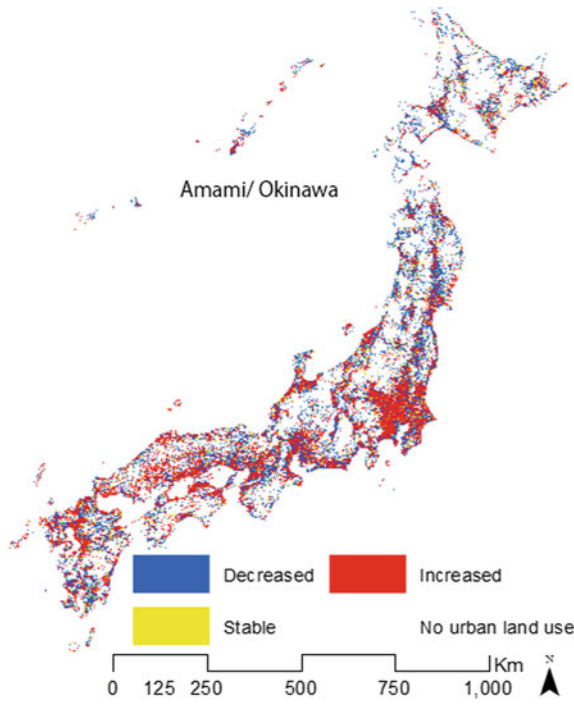


Fig. 2.22 Urban land use changes between 2006 and 2009 (Threshold 0.5 %)



shown, mostly scattered in the countryside and mainly in the mountainous areas. Figure 2.22 is the recent urban land use changes between 2006 and 2009. The threshold of the changes is set to 1/11 of the threshold of the change between 1976 and 2009 in correspondence with the period length. Compared to the recent population decrease, the recent urban land use decrease is not so strong. That is, the urban land use increase might continue in some areas, where the population decrease has already begun.

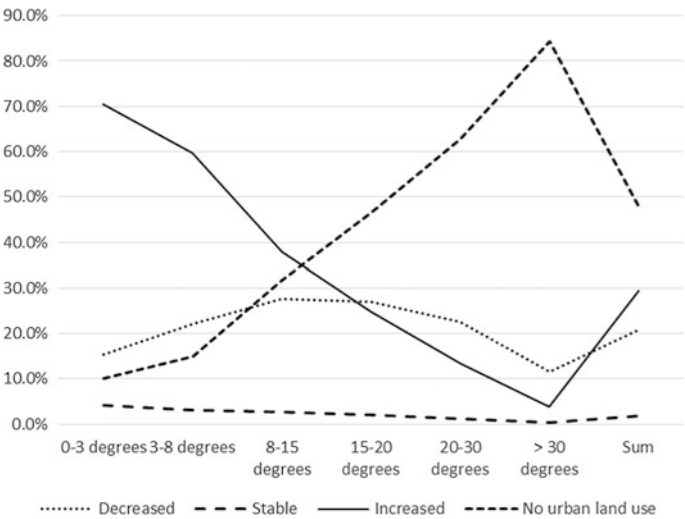


Fig. 2.23 Urban land use changes between 1976 and 2009 and land gradients (Threshold 5 %)

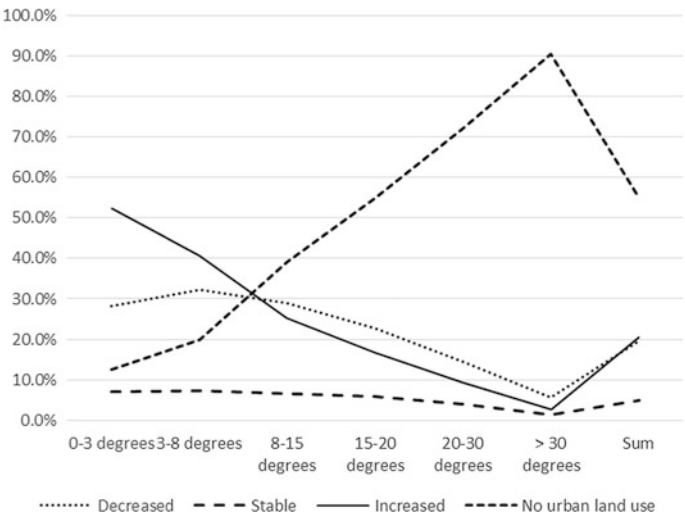


Fig. 2.24 Urban land use changes between 2006 and 2009 and land gradients (Threshold 0.5 %)

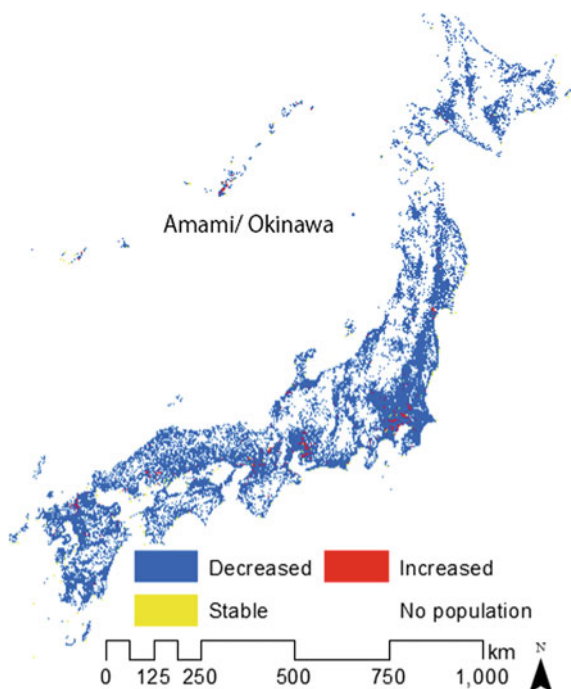
Figure 2.23 shows the relation of the urban land use changes between 1976 and 2009, and the land gradients. Compared to the population change, the increase of urban land use is higher than the decrease of urban land use in the areas of land gradients under 8° . Figure 2.24 shows the relation of the urban land use changes between 2006 and 2009, and land gradients. In the change of population, the decrease exceeds the increase between 2005 and 2006, and the increase of the urban land use remains higher than the decrease in the areas of land gradients under 8° . It might be said that the tendency of the decrease and increase of population and land uses differs according to the land gradients, and urban land use increases cannot stop easily, even when the decrease of population begins, especially in the flatlands.

2.5 Estimated Population Changes Between 2010 and 2050, and Basic Landscape Types

The Japanese Government has provided an estimate of population distribution in 1 km meshes. According to the data, estimated population changes in basic landscape types are examined in this section.

Figure 2.25 is the special distribution of estimated population changes between 2010 and 2050. The threshold between decrease or increase and being stable is $\pm 5\%$ change. Areas of increasing population are very limited in some parts of

Fig. 2.25 Estimated population changes between 2010 and 2050 (Threshold 5 %)



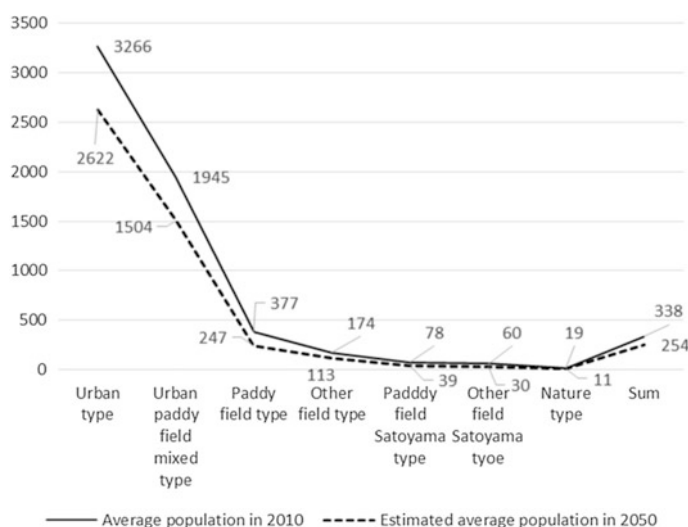


Fig. 2.26 Average mesh population in 2010, estimated average mesh population in 2050 in each basic landscape type

highly agglomerated urban areas around Tokyo, Nagoya Osaka, Fukuoka and so on. Almost all areas show a reducing trend. The extreme lack of labor for the appropriate landscape management in the future will be of strong concern. Figure 2.26 shows the average mesh population in 2010 and estimated average mesh population in 2050 in each basic landscape type.

In the highly populated landscape types such as urban type and urban paddy field mixed type, the population decrease is around 20 %. But in low populated landscape types such as paddy field Satoyama type and other field Satoyama type, the decrease in population could reach to 50 %. It is an enormous decrease and these landscape types will face a crisis of a vanishing population.

Figure 2.27 shows population changes between 1975 and 2010 in each landscape type. On the whole, the tendency of increase is stronger than the tendency of decrease in all landscape types. But in the population changes between 2005 and 2010 shown in Fig. 2.28, the decreasing tendency is greater than the increasing tendency in all landscape types. Nowadays the already shrinking phenomenon has become dominant. Figure 2.29 shows estimated population changes between 2010 and 2050 in each landscape type. In most areas of all landscape types, the decreasing tendency greatly exceeds the increasing tendency. It is easily recognized that the Satoyama landscapes in the countryside suffer from strong population decrease, but indeed in urban periphery landscapes such as urban paddy field mixed type and paddy field type, population decreases will also progress. Until now, Japan was not hit by such strong population decrease. Naturally, it is necessary as ever to consider the different measures that occur under such a strong decrease.

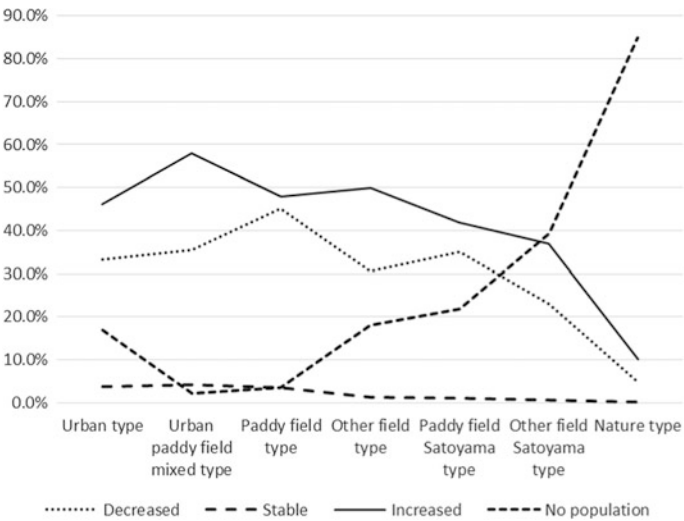


Fig. 2.27 Population changes between 1975 and 2010 in each landscape type (Threshold 5 %)

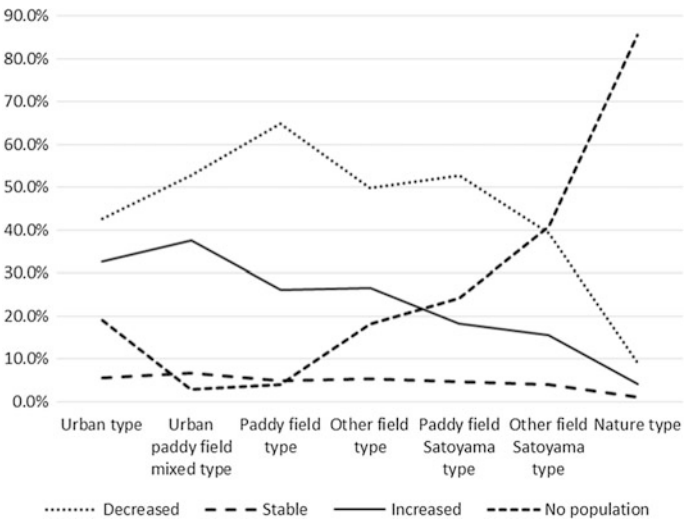


Fig. 2.28 Population changes between 2005 and 2010 in each landscape type (Threshold 0.7 %)

Figure 2.30 shows the urban land use changes between 1976 and 2009 in each landscape type. Urban land use increase exceeds urban land use decrease in the landscape types of urban, urban paddy field mixed, paddy field and other field types. Especially in the urban and urban paddy field mixed types, the decrease in urban land use is at a very low level. On the contrary, the decrease in urban land use is greatest in the paddy field Satoyama and other field Satoyama types. This means

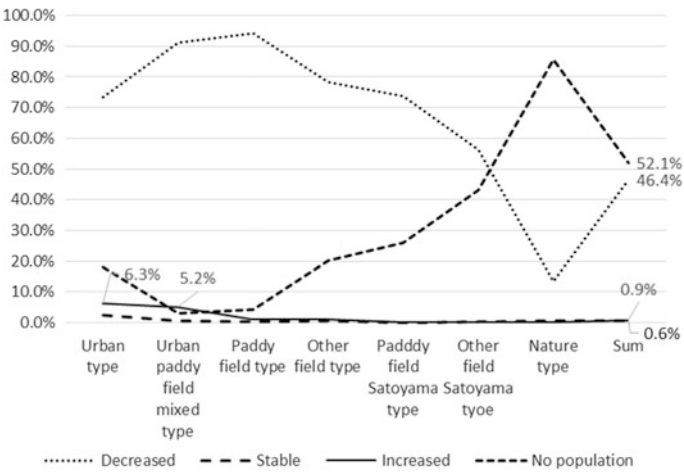


Fig. 2.29 Estimated population changes between 2010 and 2050 in each landscape type (Threshold 5 %)

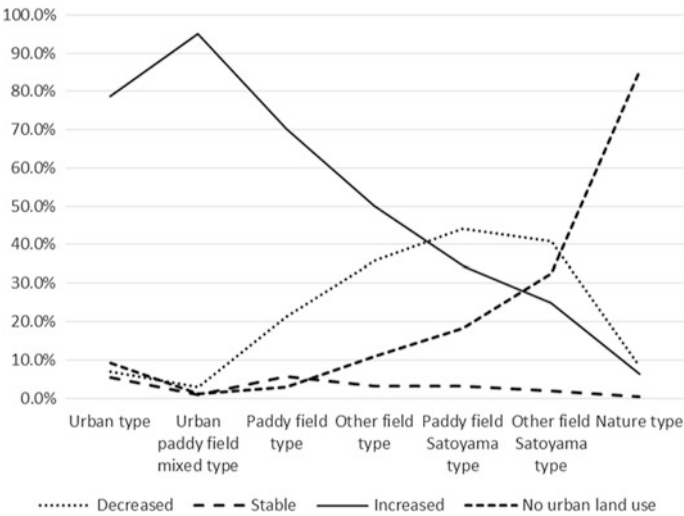


Fig. 2.30 Urban land use changes between 1976 and 2009 in each landscape type (Threshold 5 %)

that, in Satoyama areas, the decrease in urban land use has already begun in population growth periods. Figure 2.31 shows the urban land use changes between 2006 and 2009 in each landscape type. In the areas of urban, urban paddy field mixed and paddy field type, urban land use increase continues still, but remains at lower levels. In the area of other field types, the tendency to decrease changed to exceed increase.

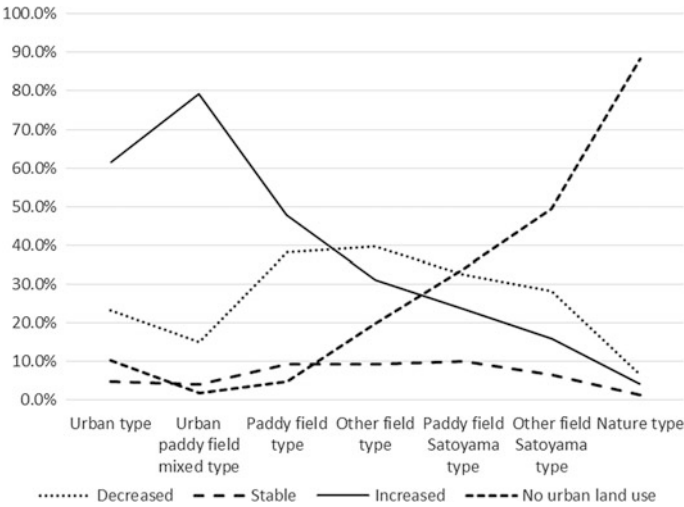


Fig. 2.31 Urban land use changes between 2006 and 2009 in each landscape type (Threshold 0.5 %)

There is no estimation of urban land use accounts in 2050. The relation between urban land use areas and population in 2050 can be estimated. Figure 2.32 shows the urban land use area per population in 2010 in each landscape type. It is interesting to see that in the other field type, the other field area per population is extremely high. It might be said that fields without paddy fields could be managed in a wider area than paddy fields, which need more labor-intensive methods.

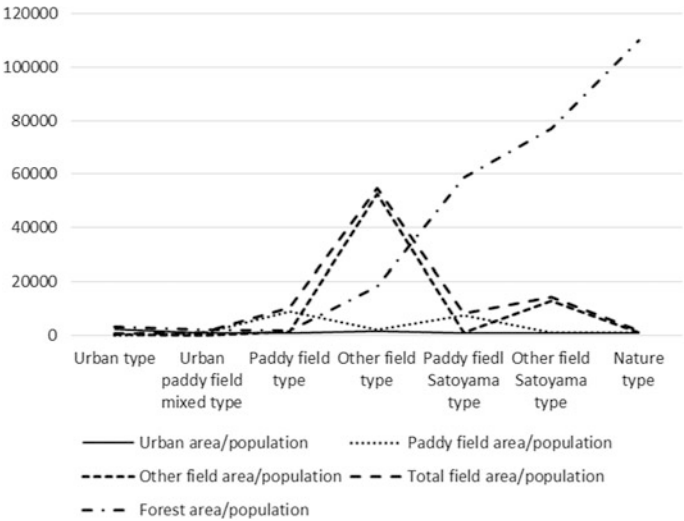


Fig. 2.32 Land use areas per population in 2010 in each landscape type

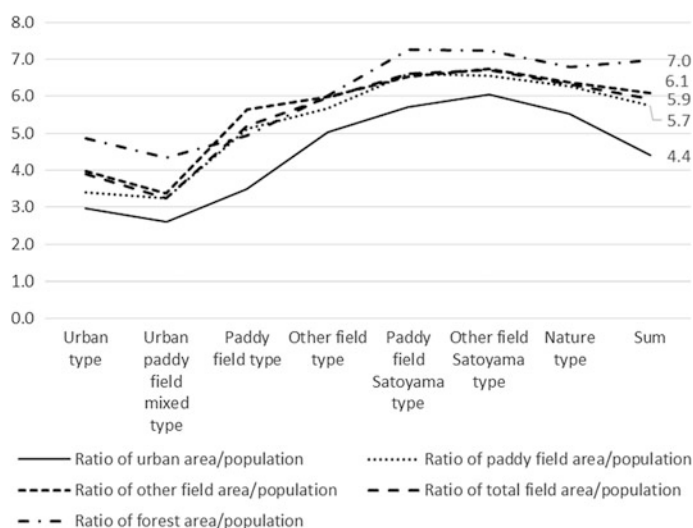


Fig. 2.33 Ratios between urban land use areas per population in 2010 and 2050 in each landscape type

Figure 2.33 shows ratios between urban land use area per population in 2010 and 2050 in each landscape type. Because of strong population decrease, managing area sizes per population of paddy field, other fields and forests will increase more than 6 times in 2050 than that of today, in the assumption that the managing area in 2050 is the same as in 2010.

As seen above, the decrease in Japanese population will hit all categories of landscape types, and land use changes will go into a very different situation than ever before. Especially rich green environments or rich ecological landscapes, which are created and maintained with collaboration between nature and human beings, will confront the lack of management labor. Each landscape type has its own management style, and impact on the environment will differ in each landscape type. It is very important to adopt appropriate ways of landscape management, thinking about the difference of working styles in each landscape type. In part III landscape management in different landscape types will be observed concretely in case studies.

2.6 Combined Analysis Between Integrated Categories of Population and Urban Land Use Changes, and Landscape Types

Usually shrinking or growing phenomena are observed as a matter of population. But the increase or decrease of urban land uses is also an important factor of the phenomena. The decrease of population is not necessarily linked to a decrease in

urban land use. And urban sprawl seems to be progressing, even in areas of population decrease.

In this report, the combined changes of population and urban land uses are calculated and examined. As available population and urban land use data are from 2005 and 2010, and from 2006 and 2009 respectively, it is necessary for the land use data to be corrected in their time periods. For the one year correction towards the previous year, the addition of 1/9 of the land use change between 1997 and 2006 is used, and the correction towards the later year, a one year extrapolation of the change between 2006 and 2009 is used. The threshold between decrease or increase and being stable is $\pm 5\%$ change.

As the integrated categories of urban land use and population changes, five types are introduced (Fig. 2.34). That is, “shrinking”, as the population stabilizes or decreases and urban land use decreases, “scattering” as the population decreases and urban land use stabilizes or increases, “remaining stable” as the population and urban land use stabilize, “expanding” as the population stabilizes or increases and urban land use increases, or “compacting” as the population decreases and urban land use decreases or stabilizes.

Figure 2.35 shows the spatial distribution of the combination changes of population and urban land use between 1975 and 2010 with the change threshold 5 %. Figure 2.36 shows the spatial distribution of combination changes of the population and urban land use between 2005 and 2010 with the change threshold 0.7 %. When comparing the two figures, the expanding tendency weakened and the scattering tendency between 2005 and 2010 became stronger than between 1975 and 2010, even though the expanding phenomena is seen in urbanizing areas.

Figure 2.37 shows the combination changes of population and urban land use between 1975 and 2010, and 2005 and 2010. Compared to the change between 1975 and 2010, scattering and shrinking occur relatively high in every category between 2005 and 2010, and the spatial character observed in Figs. 2.35 and 2.36 is confirmed.

Figure 2.38 shows the combination changes of population and urban land use between 1975 and 2010 in each landscape type. In urban, urban paddy field mixed, paddy field and other field types, the rate of expanding exceeds the rate of scattering. But in the combination changes between 2005 and 2010 (Fig. 2.39), scattering exceeds expanding in all types and shrinking exceeds expanding in the paddy

Types	Population decreased	Population remaining stable	Population increased
Urban land use decreased	Shrinking	Shrinking	Compacting
Urban land use remaining stable	Scattering	Remaining Stable	Compacting
Urban land use increased	Scattering	Expanding	Expanding

Fig. 2.34 Integrated categories of urban land use and population changes

Fig. 2.35 Spatial distribution of combination changes of population and urban land use between 1975 and 2010 (Threshold 5 %)

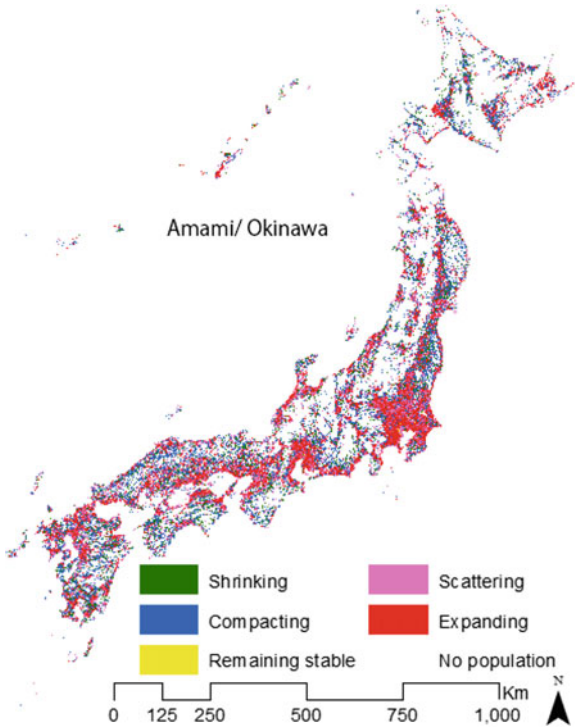
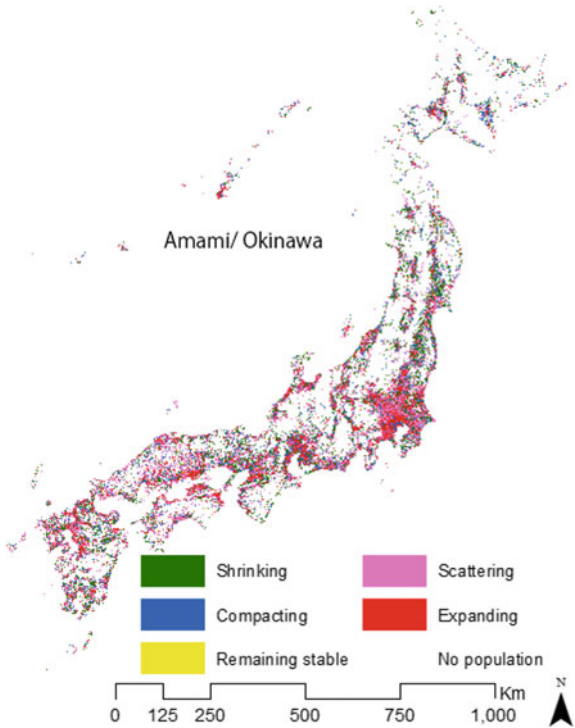


Fig. 2.36 Spatial distribution of combination changes of population and urban land use between 2005 and 2010 (Threshold 0.7 %)



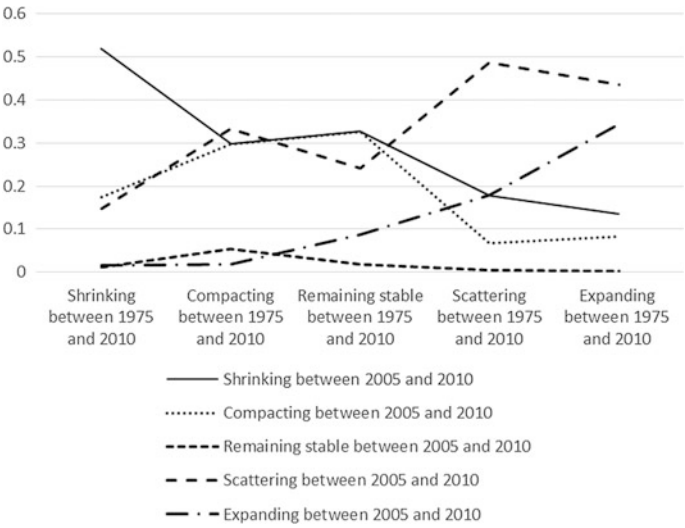


Fig. 2.37 Combination changes of population and urban land use between 1975 and 2010, and between 2005 and 2010

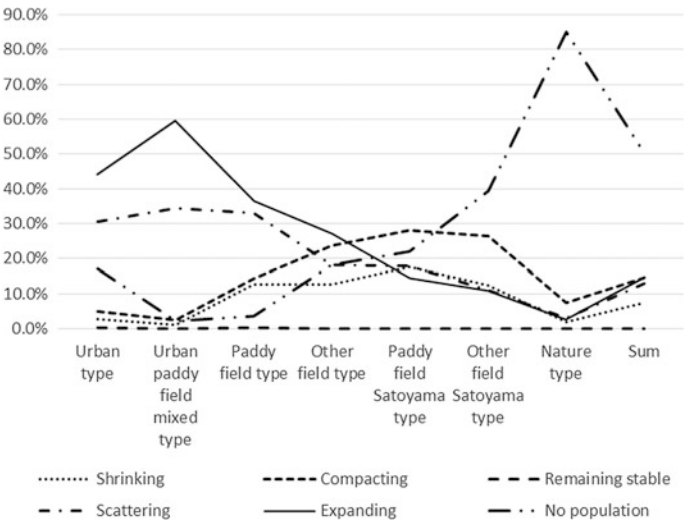


Fig. 2.38 Combination changes of population and urban land use between 1975 and 2010 in each landscape type (Threshold 5 %)

field, other field, paddy field Satoyama, other field Satoyama and nature types. This shows the dilution of urban land use is progressing in all types of landscape.

Figure 2.40 shows the population ratio of 2050 against 2010 in each landscape type. In landscape types of the countryside such as other field, paddy field

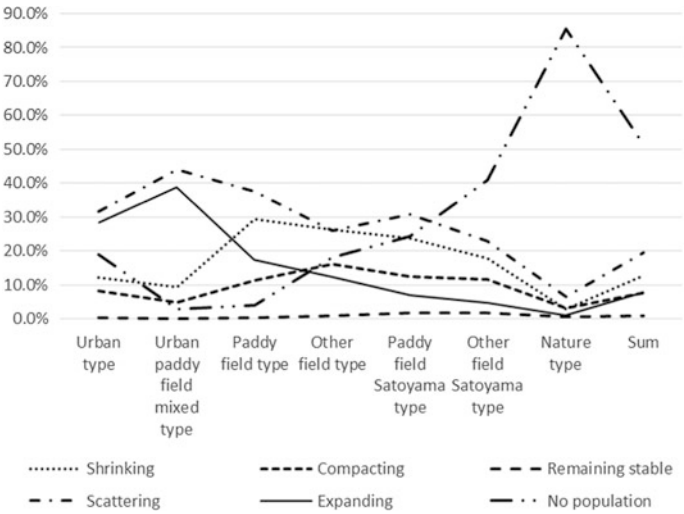


Fig. 2.39 Combination changes of population and urban land use between 2005 and 2010 in each landscape type (Threshold 0.7 %)

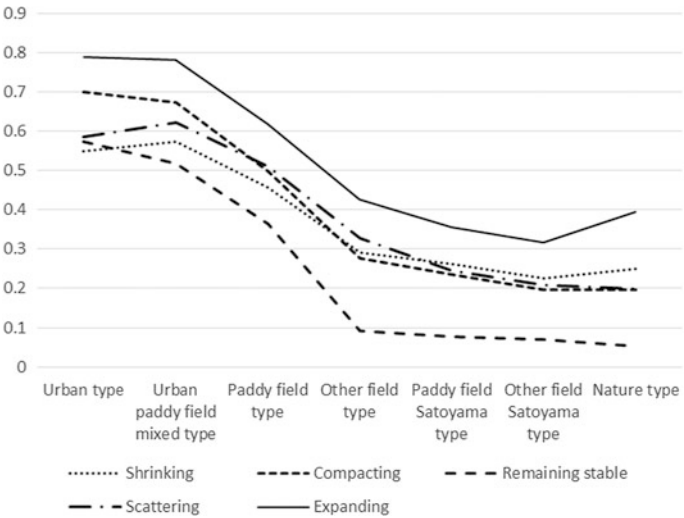


Fig. 2.40 Population ratio of 2050 against 2010 in each landscape type

Satoyama, other field Satoyama and nature types, population decline will progress at an enormous speed, and even in the expanding types, the population in 2050 will decrease to almost under 40 % of that in 2010. The other type population will decrease to almost under 30 %. Even in the urban related landscape types, such as urban, urban paddy field mixed and paddy field types, a relatively strong decrease

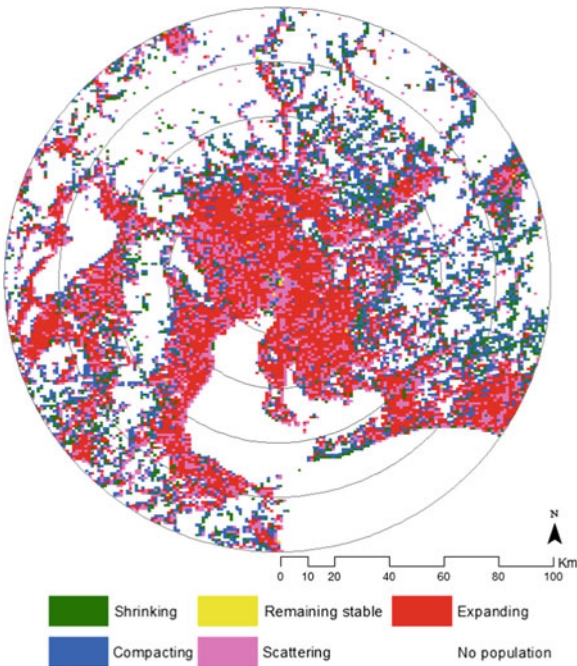
in population is observed. In such a strong population decrease, cultural landscapes of these landscape types, which are created by the collaboration of human beings and nature, might not be maintained in the same manner and size of today.

Now more detailed special distribution of combination changes of population and urban land use will be examined. Figures 2.41 and 2.42 show the spatial distribution of combination changes of population and urban land use around Nagoya city with a population of 2,276,000 between 1975 and 2010, and between 2005 and 2010 respectively. Comparing these two figures, the center of Nagoya shows scattering changes to compacting, but the expanding phenomenon is weakened and turned to scattering and shrinking.

Figure 2.43 shows the distribution of combination changes of population and urban land use between 2005 and 2010 according to the distance from the center of Nagoya. Expanding occurs mainly within the area of less than 40 km from the center, and scattering occurs mostly in the area between 20 and 40 km from the center. Figure 2.44 shows the combination changes of population and urban land use between 2005 and 2010 around Nagoya in each landscape type. Expanding can be seen dominantly in urban and urban paddy field mixed landscape types, but in paddy field, other field, paddy field Satoyama, and other field Satoyama types, the shrinking phenomenon becomes dominant.

Figure 2.45 shows the distribution of landscape types around Nagoya according to the distance from the center of Nagoya. Between 20 and 40 km urban related landscape types such as urban and urban paddy field mixed landscapes and

Fig. 2.41 Spatial distribution of combination changes of population and urban land use between 1975 and 2010 around Nagoya



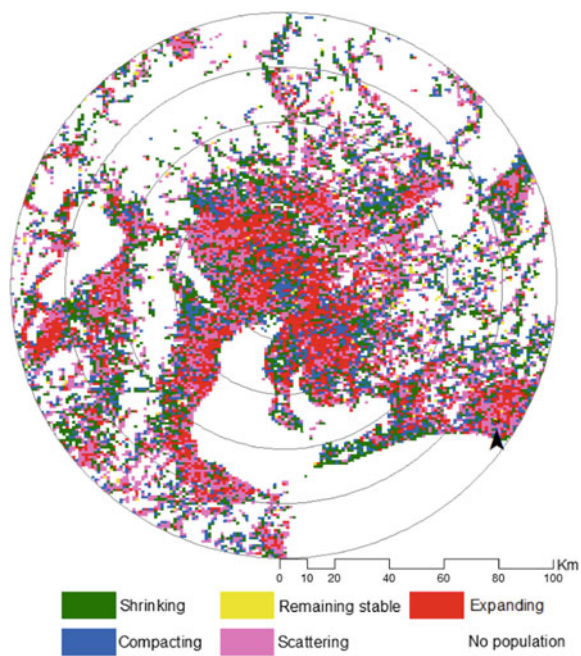


Fig. 2.42 Spatial distribution of combination changes of population and urban land use between 2005 and 2010 around Nagoya

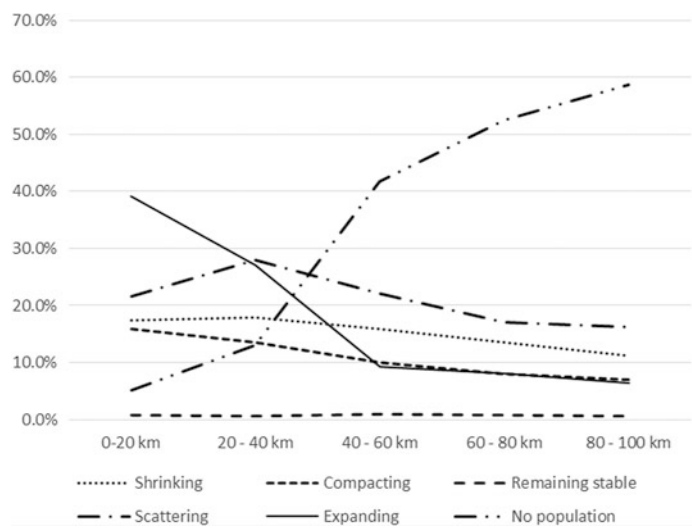


Fig. 2.43 Distribution of combination changes of population and urban land use between 2005 and 2010 around Nagoya

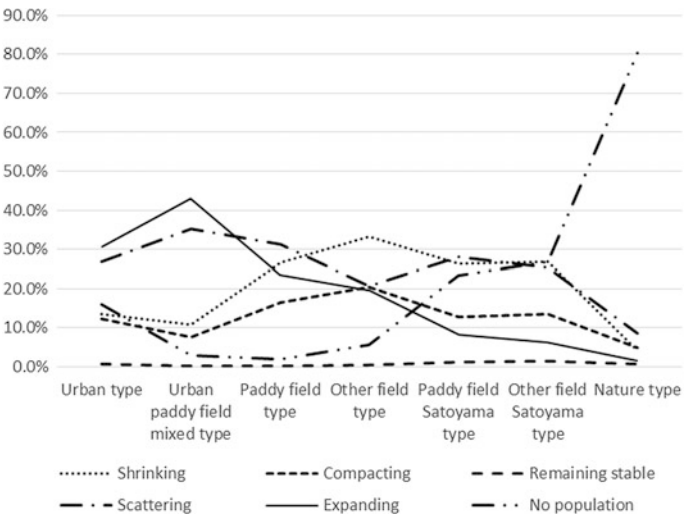


Fig. 2.44 Combination changes of population and urban land use between 2005 and 2010 around Nagoya in each landscape type

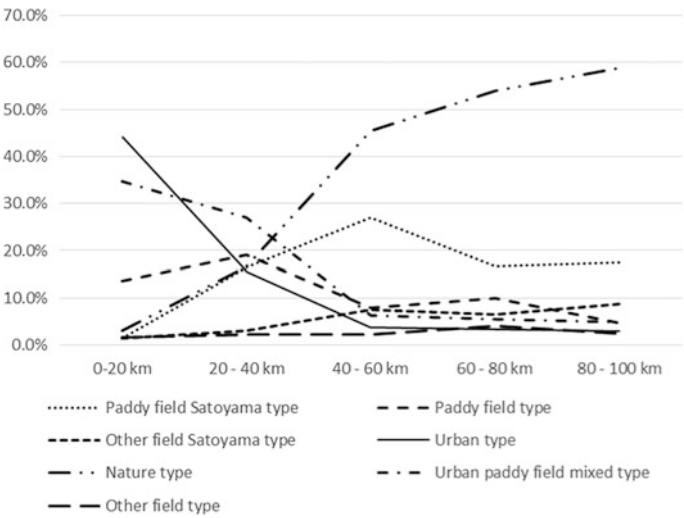


Fig. 2.45 Distribution of landscape types around Nagoya

countryside landscape types such as paddy field and paddy field Satoyama landscape types are mixed strongly and show sprawled urban peripheries. In the area more than 40 km from the center, paddy field and the Satoyama landscape become the dominant landscape types.

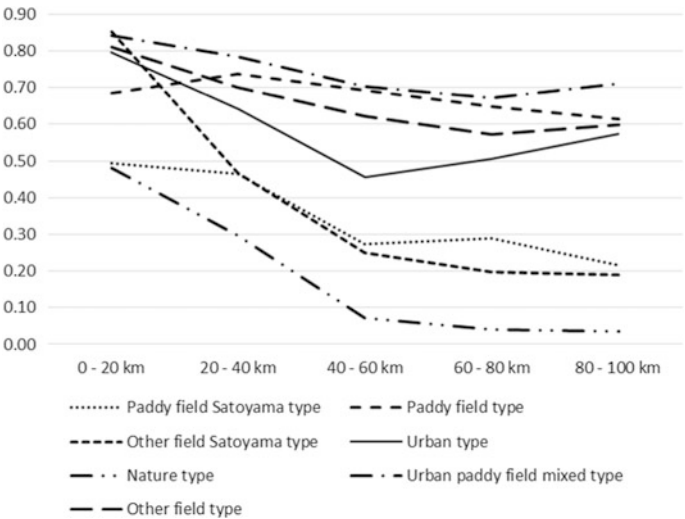


Fig. 2.46 Estimated population change ratio of each landscape type around Nagoya between 2010 and 2050

Figure 2.46 shows the estimated population change ratio of each landscape type around Nagoya between 2010 and 2050. The population decrease of paddy field Satoyama, other field Satoyama and nature types are extremely stronger than other landscape types, especially in the areas more than 40 km from the center. Figure 2.47 shows the population ratio of 2050 against 2010 in each landscape type

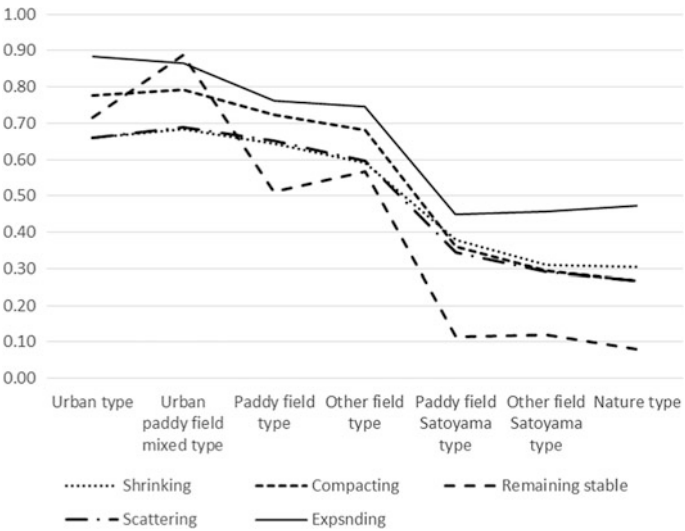


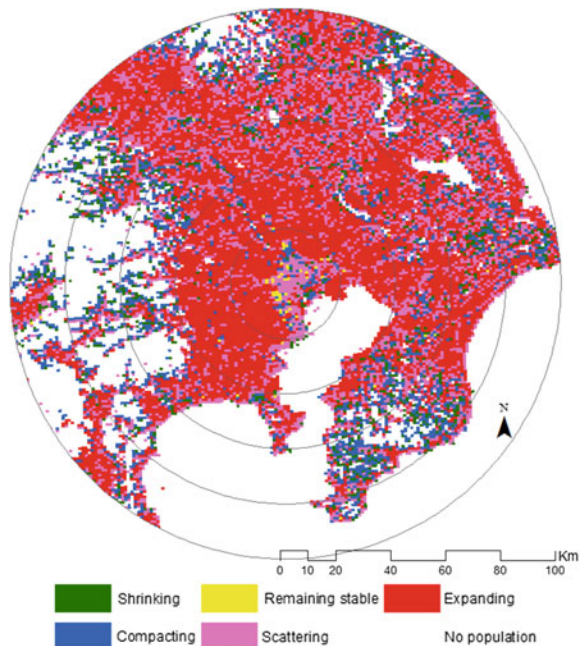
Fig. 2.47 Population ratio of 2050 against 2010 in each landscape type around Nagoya

around Nagoya. Strong population decline can be observed here also in paddy field Satoyama and other field Satoyama landscape types. Nagoya is one of the most active industrial districts, but shrinking and scattering phenomena around Nagoya are progressing and mosaicked structure of shrinking, scattering, compacting and expanding can be observed clearly. And in the periphery of such active areas, Satoyama landscape types are confronting the crisis of disappearance through population decline.

Figures 2.48 and 2.49 show the spatial distribution of combination changes of population and urban land use around Tokyo city between 1975 and 2010, and between 2005 and 2010 respectively. As seen in the comparison of Nagoya, the city center changes from scattering to compacting, and in the peripheries expanding changes to scattering or shrinking. Especially in the eastern and northern part of the periphery shrinking phenomenon is strongly observed.

Figure 2.50 shows the distribution of combination changes of population and urban land use between 2005 and 2010 according to the distance from the center of Tokyo. Expanding occurs mainly within the area of less than 60 km from the center, and scattering occurs mostly in the area between 40 and 80 km from the center. Figure 2.51 shows the combination changes of population and urban land use between 2005 and 2010 around Tokyo in each landscape type. Expanding can be seen dominantly in urban and urban paddy field mixed landscape types, but in paddy field and other field types shrinking phenomenon becomes higher, and in paddy field Satoyama, and other field Satoyama types, shrinking becomes dominant.

Fig. 2.48 Spatial distribution of combination changes of population and urban land use between 1975 and 2010 around Tokyo



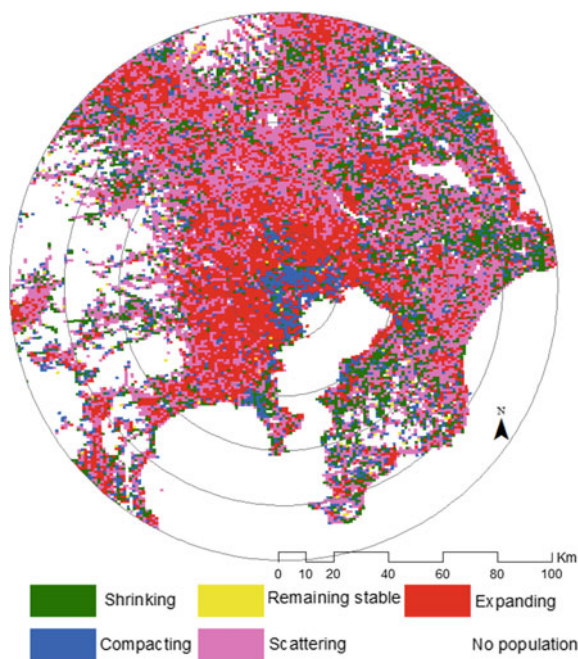


Fig. 2.49 Spatial distribution of combination changes of population and urban land use between 2005 and 2010 around Tokyo

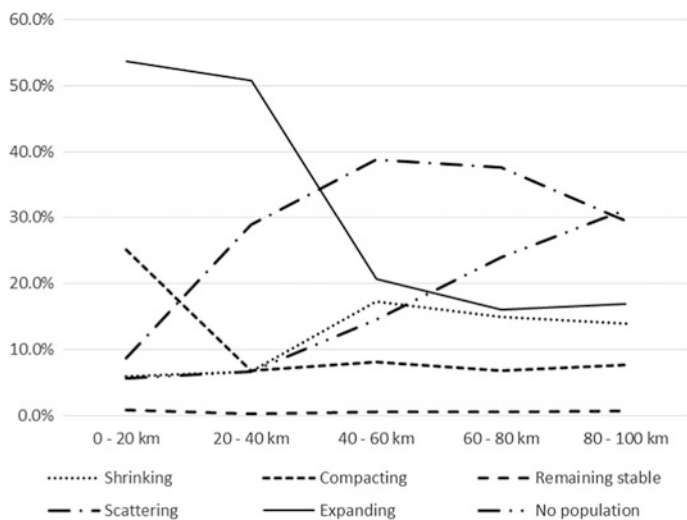


Fig. 2.50 Distribution of combination changes of population and urban land use between 2005 and 2010 around Tokyo

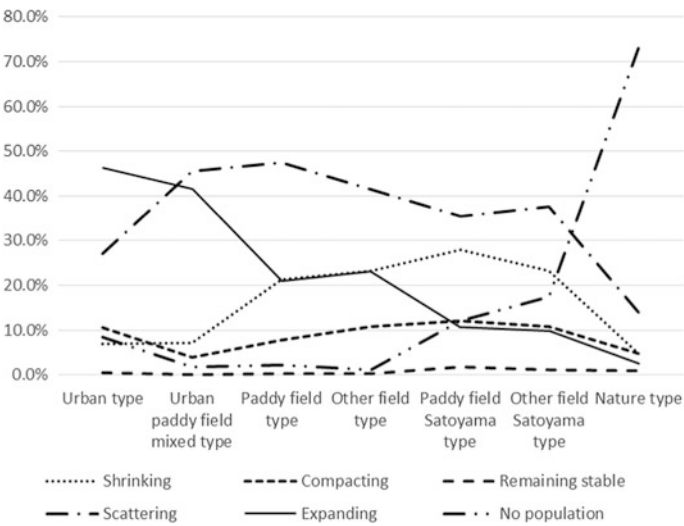


Fig. 2.51 Combination changes of population and urban land use between 2005 and 2010 around Tokyo in each landscape type

Figure 2.52 shows the distribution of landscape types around Tokyo according to the distance from the center of Tokyo. Between 40 and 60 km urban related landscape types such as urban and urban paddy field mixed landscapes and countryside landscape types such as paddy field, other field Satoyama and paddy field Satoyama landscape types are mixed strongly and show sprawled urban

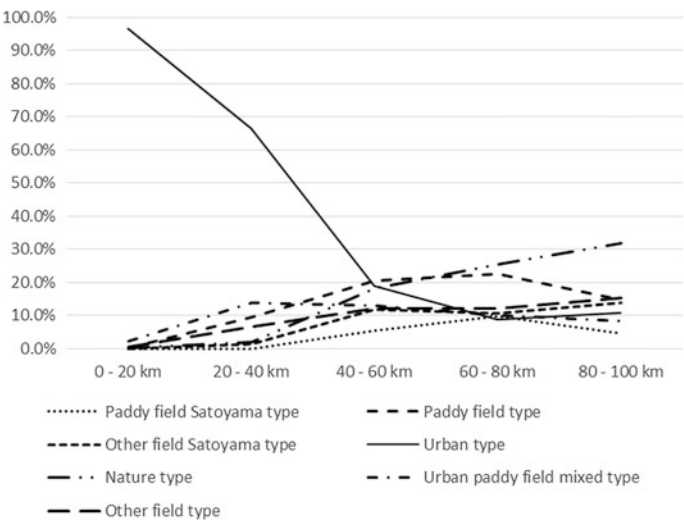


Fig. 2.52 Distribution of landscape types around Tokyo

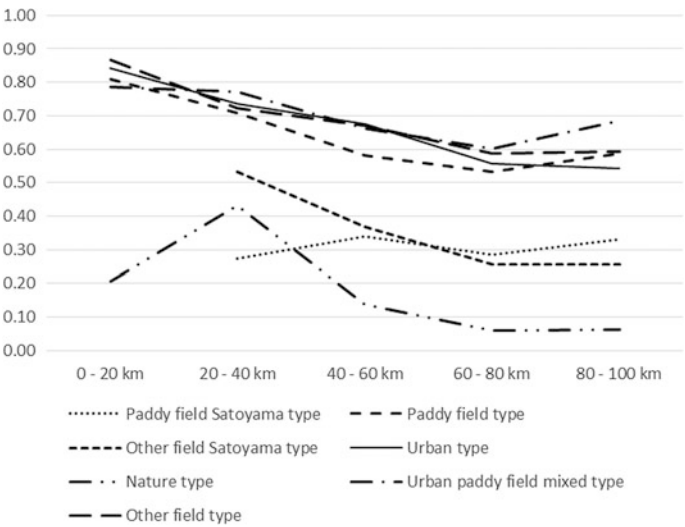


Fig. 2.53 Estimated population change ratio of each landscape type around Tokyo between 2010 and 2050

peripheries. On the contrary, in the area more than 60 km from the center, urban types decrease to nearly 10 %.

Figure 2.53 shows the estimated population change ratio of each landscape type around Tokyo between 2010 and 2050. The population decrease of paddy field Satoyama, other field Satoyama and nature types is much stronger than other landscape types in the areas more than 20 km from the center. Figure 2.54 shows

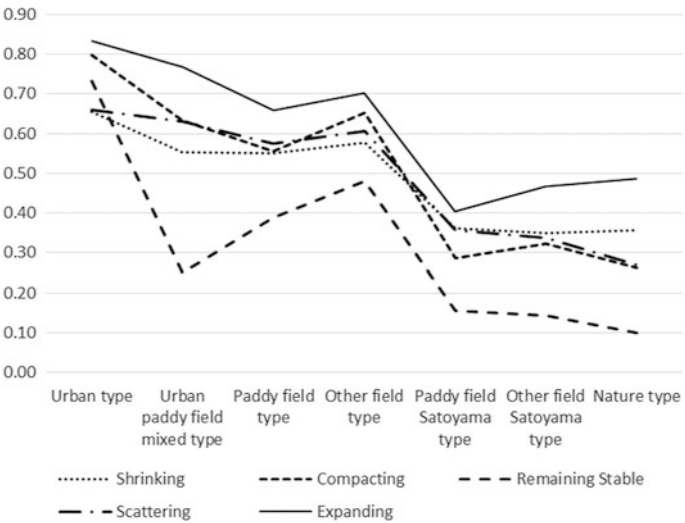


Fig. 2.54 Population ratio of 2050 against 2010 in each landscape type around Tokyo

the population ratio of 2050 against 2010 in each landscape type around Tokyo. A strong population decrease can also be observed here in paddy field Satoyama and other field Satoyama landscape types. Not only Nagoya but also in the periphery of the metropolitan area of Tokyo, mosaicked structure of shrinking, scattering, compacting and expanding are observed more clearly and Satoyama landscape types are confronting the crisis of disappearance.

2.7 Conclusion

The following facts are clarified. There are many scattering areas around big cities where urban land use is increasing and the population is decreasing. And a mosaic structure of shrinking, expanding, compacting and scattering in the peripheral areas away from the city center becomes clear.

It is also clarified that the land gradient regulates the development of urban land use, and land use of paddy and crop fields can easily be changed to urban land use. Even when there is a tendency for the population to shrink, land use “scattering” and partially “expanding” might continue in flatlands.

In the typical country landscape types such as paddy field Satoyama and other field Satoyama types, population decrease will progress in rapid speed in the future, and in the long term continued traditional cultural landscapes, such as Satoyama, might continuously decline.

But not only in Satoyama, but also in urban type landscapes, population decrease will progress in a certain amount, and ecological and cultural management of urban green spaces will be in crisis because of the lack of maintenance budget and labor forces.

These phenomena will lead to the unsustainability of landscape management all over the land. For protecting from such crisis, we need to know the exact amount of the management ability of all kinds of landscapes and landscape elements. The concept of “Landscape management labor accounts”, proposed in this book, can serve for this purpose. This research was carried out in 2015 by the help of the Center for Spatial Information Science, the University of Tokyo.

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Labor Forces and Landscape Management

Japanese Case Studies

Shimizu, H.; Takatori, C.; Kawaguchi, N. (Eds.)

2017, XV, 456 p. 268 illus., 236 illus. in color.,

Hardcover

ISBN: 978-981-10-2277-7