Compact City Analysis in Northern and Eastern Areas of Japan

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Abstract: In this document we want to study and give an approach of how to deal with large scale cities in the northern and eastern part of Japan contrasting with Aomori city.   For this study we take in count a period of time consisting of 3 years, 1991, 1997 and 2006, with this information we evaluate the land use control and promotion areas in Sapporo, Sendai and Aomori cities. Also we study the population density in different areas of each city, to understand how to achieve a compact city model.

Keywords: Compact city, urban sprawling, land use, land use transformation, GIS.

1. Introduction

The compact cities techniques have been apply around the world. Japan for its land features have applied this method to some areas along the country, cities as Aomori and Toyama are examples of compact cities currently used in Japan. This study is an approach of how to deal with large scale cities in the northern part of Japan from the point of view of compact cities. Sapporo and Sendai city were chosen because the population density is higher than other cities in the country, and the sprawling is increasing. The main goal is improve the internal conditions of the cities, proposing some changes in the land use.

The term of compact cities has been defined in a first moment by Dantzig and Saaty as a place with high population density, a place where there is less dependence of automobile, a mixed land use, a diversity of life, social fairness and Independency of governance (Dantzig and Saaty, 1974).   From this point of view it is said that the compact city is sustainable because the energetic supplies and disposal of garbage are well used (Suzuki, David. 2003), there is a reduction of automobile dependence, and related problems due to urban sprawling as the loss of wildlife, the recreation spaces, loss of historic character of towns and villages and CO_2 emissions.

2. Methods

2.1   Information process

In order to analyze the situation inside the cities, the geographical and demographic information was obtained from different sources as the Ministry of Land, infrastructure, transport and tourism from Japan (MLIT), the statistical homepages of Aomori, Sapporo and Sendai city, and the geographical information was downloaded from the Land Use control Back-up System (LUCKY) which helps to obtain the information related with the land Use in the different areas of Japan. For this study we will analyze the changes using 3 periods of time 1991, 1997 and 2006.   The information related

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with the land use was obtained from the MLIT, with information each 100 meters (100 mesh), this information is useful to analyze in a more precisely way the activities which are being doing within the area. The second step was to get the information of the land use provided by LUCKY system, this information was extracted as an image, for that reason different types of software were used to convert that information into shapefiles, those software were useful for images processing (GIMP) in order to extract just the information required.   After the process this information was converted into GeoTIFF files from ArcGIS v.10, and the System for Automated Geoscientific Analyses (SAGA) software was used to convert the information into polygons.

The demographic and geographic information was gathered into R software v.2.12, all the database was joined in order to construct the mathematical models and the statistic calculation of the cities.

3. Results

Let us present a general information of the cities which are being studied in table 1.

3.1 Aomori city

Aomori city presents a structure in its land use system as we shown in Figure 1.   This picture shows the information related with land use control, land use promotion, districts and zoning area of Aomori city. In order to understand how the cities are being changing during the interval of time we will analyze the specific information given by the government into the mesh files. Each area has information related with specific activities shown in table 2.

Table 1. General Information

City	Area(Km^2)	Population	Density(p/Km^2)
Aomori	824.52	302,915	367.38
Sendai	788	1,046,654	1,328.24
Sapporo	1,121.12	1,918,868	1,711.56
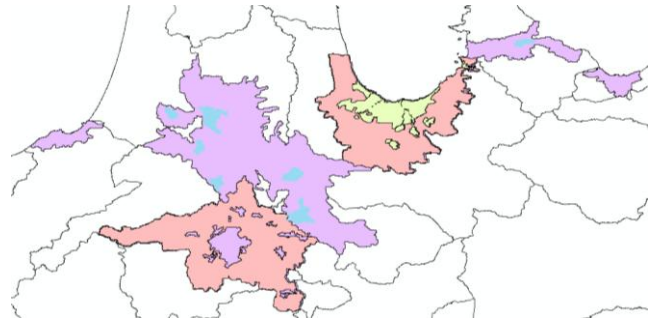
Figure 1. Aomori city areas

Table 2. Specific content of Mesh information

Code	Corresponding content
1	Paddy field
2	agricultural land
3	NA
4	NA
5	Forest
6	Waste Land
7	Urban area
8	NA
9	Transportation land
A	Other land
B	Rivers and lakes area
C	NA
D	NA
E	Beach
F	Sea
G	Golf course

The value NA means that for this code there is no correspondence.

Figure 2. Land use control for Aomori city

Figure 3. Land use promotion for Aomori City

Figure 4. Demographic situation in Aomori city
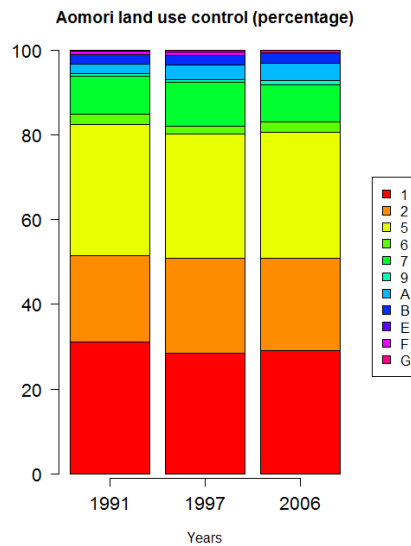
The information of land use control for Aomori is summarized in figure 2:

According with this information the transportation land has been increasing from 0.69% in 1991 reaching the 1.01% in 2006, for other land from 2.33% to 4.04%, however information according with agricultural land, urban area are decreasing in small scale. We realized that this area has been controlled efficiently by the government during this period of time.

The information related with Land use promotion area is summarized in Figure 3.

During this period of time, areas as: urban area has increased from 55.78% in 1991 to 68.62% in 2006, other land from 10.81% to 13.89%. On the other hand areas designated to rice fields have decreased rapidly from 11.43% to 4.43% also the Golf areas from 6.83% to 0.96% in 2006.
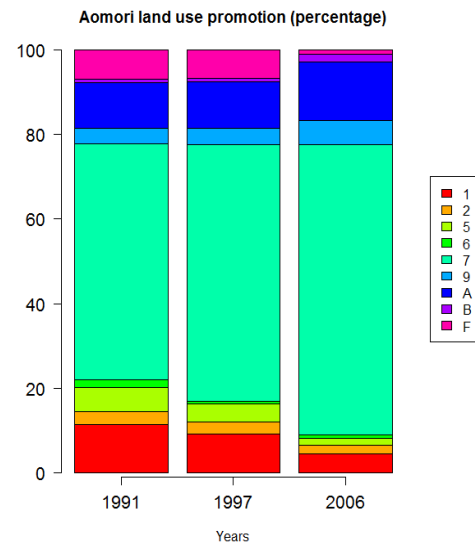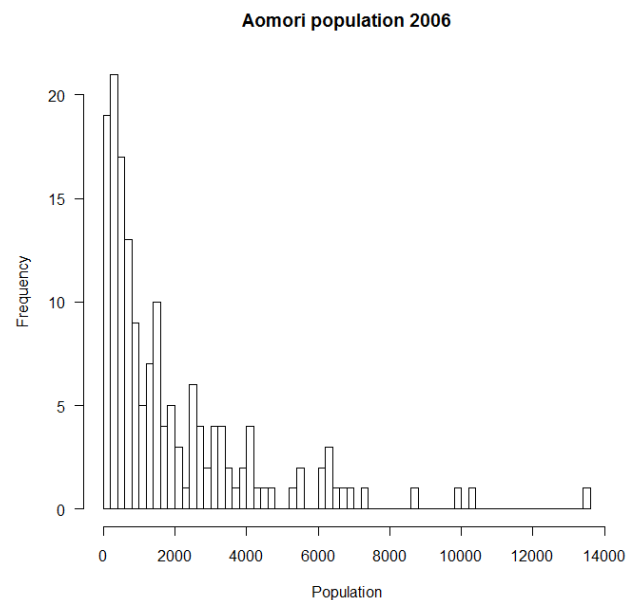
The Demographic situation in Aomori city is shown in Figure 4, it presents the population groups, where the 80% of the groups are between 0 and 3000 people living in a same town. This information was obtained from the city homepage which presents the result of how many people are living together in the towns in 2006, after we calculated the centroid of the areas in order to study the population density each 100 m (mesh 100).

3.2 Sendai City

Sendai city (Figure 5) presents the structure of control, promotion land use, district and zoning areas all over the city.

Same as Aomori city, detailed information was extracted from mesh data.

The land use control for Sendai in this period of time does not present major changes. The agricultural area decreased from 5.38% to 4.2% and rice field decreased 1.3%, this two contents are the most representative changes during this period.

Nevertheless the promotion area of Sendai has important changes in urban area increasing 27.6%, the area designated to forest decreased 11.06% and rice fields also decreased in 7.55%.

For the demographic data in the period of 2006, the density is presented in the Figure 8. According with the last figure we realized that the high population density is located in the center of the promotion area, we noticed that it is important to reduce the sprawling because it is reaching the control area.
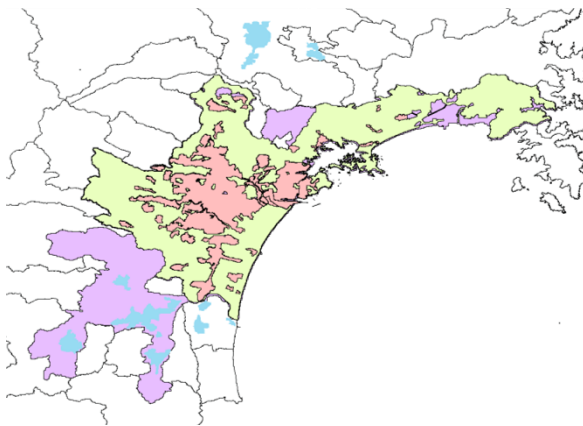

Figure 5. Sendai city areas

3.3 Sapporo city

This city presents the next characteristics in its land use, shown in Figure 9.:

The city of Sapporo is occupying a large area in the prefecture according with the zoning area and the areas here studied.
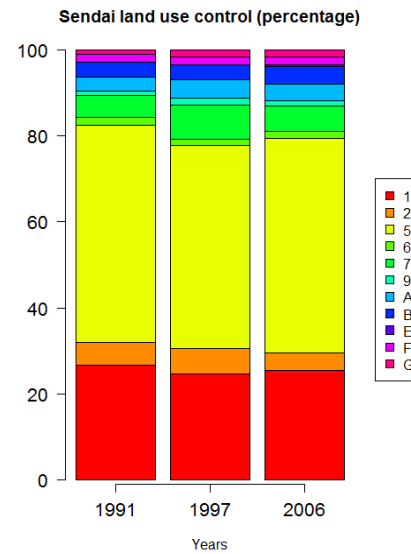

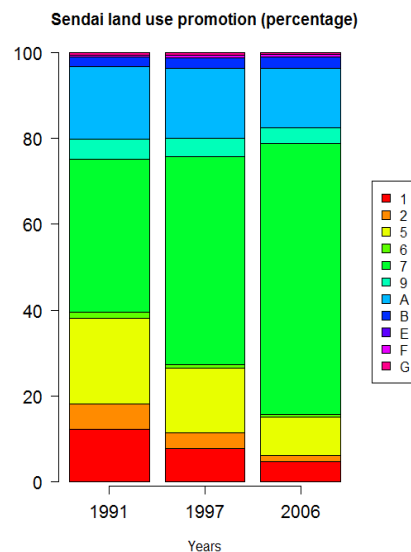Figure 6. Sendai land use control
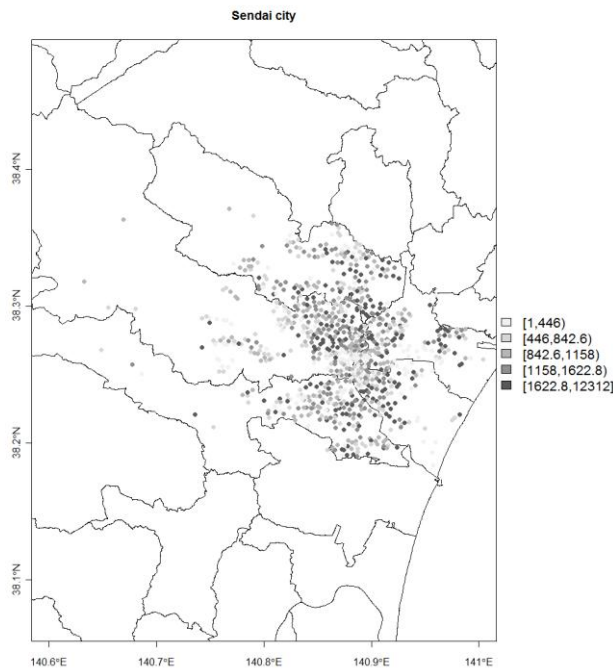

Figure 7. Sendai land use promotion

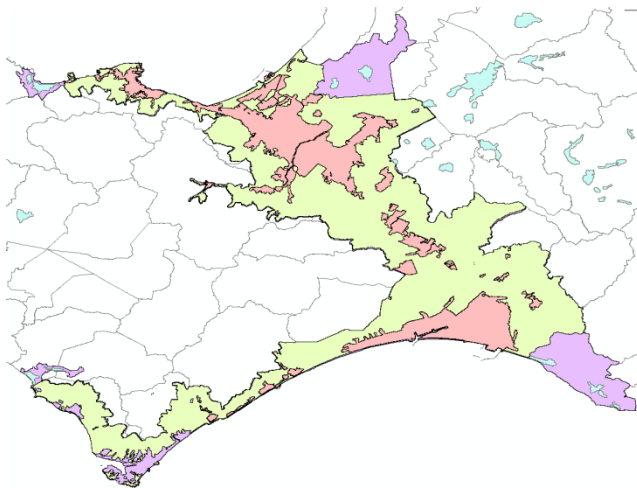Figure 8. Demographic situation in Sendai city

Figure 9. Sapporo city areas

The city does not present major percentual changes in the land use control, nevertheless the most important changes are presented in the forest area which decreased 2.7% in this period of time, the wasting land (code 6) decreased in 2.5%, and rice fields in 1.82%.
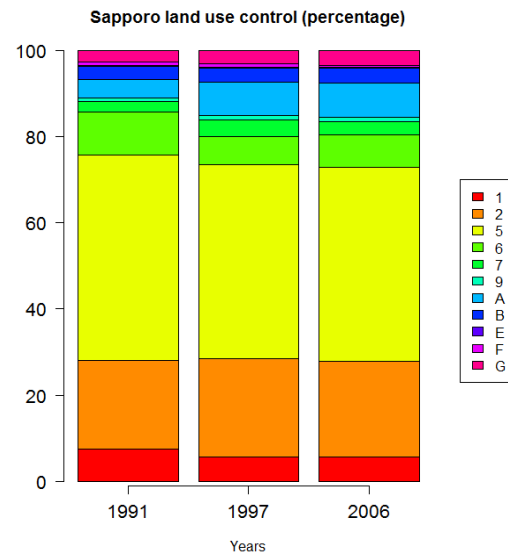

Figure 10. Sapporo land use control

However other sites increased in 3.67% and the agricultural land in 1.59%.

Land use promotion area presents an important growth in urban area in 20.9% between 1991 and 2006, occupying a total of 52.56% of the promotion area, and transportation land was just 0.3%. The relevant areas which decreased during this period were agricultural land in 5.66%, the forest area in 5.46% and the area designated for waste land decreased in 4.70%.

For the demographic information we have been analyzed the population density in 2006 to understand the urban sprawl, and the behavior into the city. In the Figure 12 we noticed that there are 4 areas with a high population density, this points falls into the land promotion area, but we notice that there are some important groups reaching the control area, this suggest the importance to control the urban sprawling.

4. Conclusions

In this analysis we realized that land Use of Aomori from the point of view of compact city has an area well defined, while Sendai and Sapporo shows a large land use area and the sprawling has been increasing at high rate. Activities as agricultural, forest and waste land have been decreasing in an important rate in the cities without a compact city development.

5. Discussion

According with Elkin et al. (1991) a compact city promotes the "intensification of the use of space in the city with higher residential densities and centralizations" from this point of view, Aomori is a city which has been working to achieve this structure (Figure 1) according with their master plan. For that reason it is important to achieve this system in large scales cities as Sendai and Sapporo; this structure will help to centralize the activities and the government, preventing the urban sprawling and the problems due transportation. Also this situation will help to gather the high density population in a specific area, as we noticed in (Figure 12) some groups of high density are spread into the promotion area, and other groups are reaching the control area generating sprawling.

Acknowledgment

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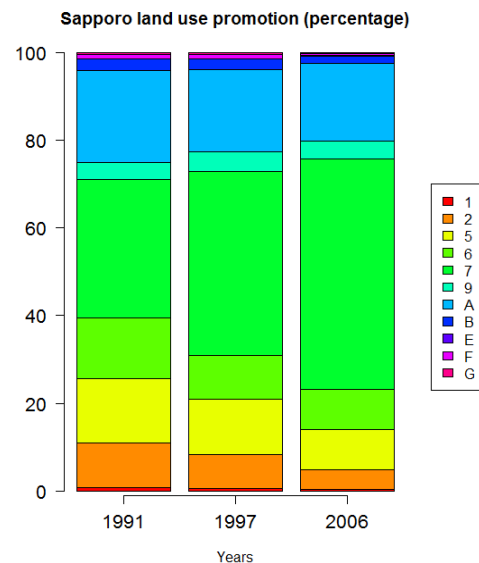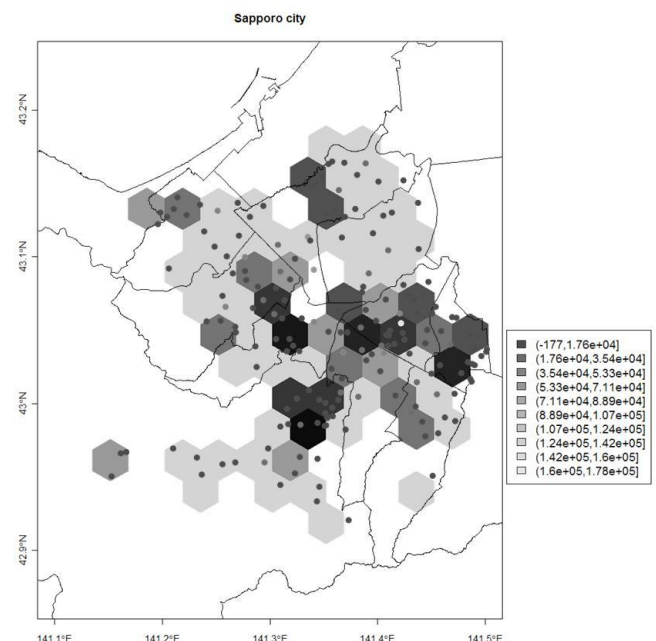
Figure 11. Sapporo land use promotion

Figure 12. Population density in Sapporo city