

A Concept of Land Administration tool against City Sprawl

Yoko HORIE, Saaya KOBAYASHI, Masaru KAIDZU, Japan

Key words: City Sprawl, GIS, Cadaster

SUMMARY

In 2015, Japan experienced a decline in total population for the first time since National census started in 1920. With the persistent demographic change, many municipalities are facing serious problems such as devastation of central area. Although the population decreases, in many cities sprawling into the suburbs has been still in the process. This phenomenon is not only a city problem but it is closely connected to efficiency of suburban agriculture. That is because in Japan, marginal area between city and rural village is the area of highest agricultural productivity.

To control undesirable sprawl of city, usual tool for municipal government are zoning and development plan. To make proper plan and efficient explanation, it is necessary to assess merit and cost of each development plan and present them clearly on maps and statistics. The basic information for such assessment and presentation contains present zoning, land use, existing social infrastructure and population distribution together with temporal variation of those. As acquisition of land is a very important procedure in development, the information should be related to land parcel. Due to historical reason, land ownership in paddy field and farm are small in scale and land acquisition is always a big issue.

Simulation of future economical environmental and social impact of alternative development plans will support right evaluation of those plans. The evaluation should be done not only from city side view point but also from agricultural view point. For such evaluation based on communication over objective estimates, GIS based on LADM will be the best tool. This problem is many departments' concern. This tool should collect data from many DBs in the municipality. Security measures will be applied and data will be transferred. Frequently used process will be prepared as a module and users can select modules and compose suitable system easily. A conceptual design of such tool is proposed.

A Concept of Land Administration tool against City Sprawl

Yoko HORIE, Saaya KOBAYASHI, Masaru KAIDZU, Japan

1. BACK GROUND

In 2015, Japan experienced a decline in total population for the first time since Census started in 1920. Japan enjoyed increase of population for a century. While this period, population kept flowing into cities. To control expansion of urban area, zoning and City Plan were employed in Japan. The zoning was rather tight, still irregular expansion of cities occurred especially in suburban area.

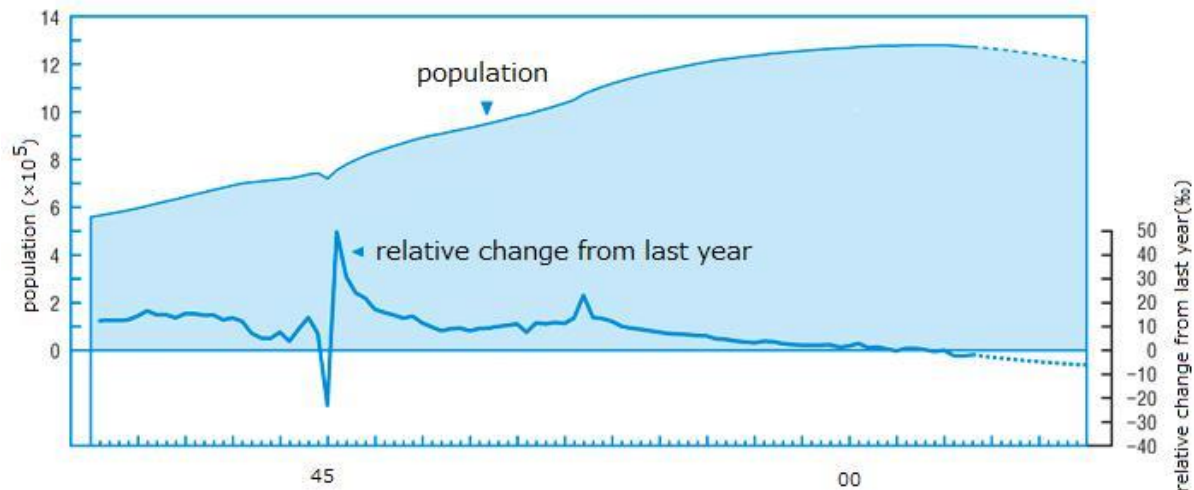


Fig.1 Temporal variation of Population of Japan
(after Ministry of Health, Labour and Welfare)

Although many municipalities experience decline of population, city sprawl do not stop yet presently. In addition to sprawl, such local cities suffer from increase of vacant houses or lots like warm eaten spot. City sprawl increase maintenance cost of infrastructure, cost of service through decrease of population density and threaten security of life in central part of city where vacant houses increased. In addition, Agricultural land near cities in Japan are fertile and close to market. It is not wise to change farm yard into residential area when city center suffers from vacant house and land.

To handle these problems properly, we need simple tool which model the situations so that municipalities or communities can use for simulation or presentation. With such a tool, planners can communicate with residents and even residents can participate in planning process to avoid unnecessary dispute afterward.

2. EXISTING RESEARCHES ON CITY SPRAWL

A Concept of Land Administration Tool against City Sprawl (8769)
Yoko Horie, Saaya Kobayashi and Masaru Kaidzu (Japan)

FIG Working Week 2017
Surveying the world of tomorrow - From digitalisation to augmented reality
Helsinki, Finland, May 29–June 2, 2017

This phenomenon is already noticed by researchers, for example, Sidentop and Fina (Sidentop, Fina,2008). As is stated in their paper, city sprawl may continue even under decline of population, as is observed in Japan. When population is decreasing and sprawl continues, it will automatically cause dissolving of city into sparsely spread area with vacant land lots and unused buildings. This will rapidly increase cost of infrastructure per capita and increase car traffic that increase threat to environmental condition. Such studies on economical or environmental cost of city sprawl can be found easily in preceding studies (for example, Schultink,2009, Resnik,2010).

In Japan, city sprawl under decline of local population was noticed about decades ago. We can find many papers in Japanese language. They indicate some empirical relations observed in Japan. Using such locally significant relations, we designed a GIS tool easily handled for officers in municipalities or members of communities so that they can make simulation and presentation for discussing on suitable policy.

2.1 Preceding studies and useful indexes

For designing a tool, we need to know how city planners and policy makers analyze the sprawl phenomena and keep their eyes on which indexes.

Preceding studies describe situation and tendency of city development. The indexes they used will be useful for municipalities or community also. We will list up indexes and point of discussion and then discuss some additional indexes. Oueslati et.al (Oueslati, Alvanides and Garrod, 2015) documented (theoretical and empirical) determinants of urban sprawl. Starting from this, we concentrate more on the phase of population decrease in the area concern.

2.1.1 Drivers of city sprawl

City sprawl is not a simple process. Several drivers are identified. For example, Urban sprawl in Europe (EEA/FOEN,2016) list up demographic, socioeconomic, political, technological and geophysical drivers. Indexes interested in this document are population, rate of single family dwelling, migration of elder people as demographic, GDP, GDP per capita, land price and construction cost, automobile, life style as socioeconomic, taxation as political, easier commuting as technological and irreclaimable area as geophysical. They are basically consistent with discussion in Japan. However, this kind of social problems are under influence of local cultural background. For example, Japanese survey shows elder people in Japan tend to stay in their home town rather than moving out for sunny sea shore. When they need continuous assistance, they will move to nursing home or sometimes house of their children. Tools must be flexibly handle such local diversity.

2.1.2 Demographic change and tendency of city sprawl

In the paper “How Is Urban Sprawl under Population Decrease Like?” (Muromachi,2003), Muromachi discussed relation of some indexes in census data to decrease of population density. He found rate of aging, rate of single family dwelling and position in metropolitan area are affecting decrease of population density change. Where rate of aging is high (more than 20%), population

density decrease (more than 50% of such area show decrease of more than 10%). Where rate of single family dwelling exceeds 90%, population density decrease. Densely populated areas are stable. These indexes will be included although they should be checked with recent census data.

Kobayashi (Kobayashi 2012) pay attention to family and dwelling. He found decrease of population will cause decrease of number of households in 10 years of time lag. Decrease of households, however does not lead to decrease of houses. Hollowing out of city centers cannot be removed through market.

In Bank of Japan Working Paper, Tsuchiya (Tsuchiya,2009) discussed effect of urbanization using population in DID.

There is another problem in so, called “New Town” developed in suburban area. The price is affordable to young people. Thus, residents tend to become mostly in similar age. Later, all of residents get old altogether. The new town relies on automobile for commuting and shopping. This will become impossible when residents reach some age. And that occurs almost instantly when it occurs. In other word, the new town is not sustainable in many cases. We should make long term plan to cope with this problem also.

3. DESIGN OF A TOOL

The authors of this paper are not city planner but surveyor who prepare GIS tool to support municipalities or communities. We will prepare GIS with data and application suitable for coping with above discussed problem. As the city sprawl is finally land management issue, the tool should be based on cadastral data. Available official data are reviewed shortly and dataset for the tool is listed up. Then, some indexes to be estimated are listed up and a data model is proposed.

3.1 Cadaster in Japan

In Japan, as usual in many other country, cadaster and registration are closely connected but differently maintained. In cadastral survey, followings are surveyed. They are location and shape of parcel surveyed referring National Geodetic Coordinates System, owner of the parcel and land use. When cadastral survey is finished and the result is approved, it is used for immovable taxation in municipalities and a copy is sent to registry office to be reflected on land register. Section in charge of immovable tax maintains maps and book which include building information surveyed at the epoch of new year.

3.2 Land evaluation

One of the important driving factor of sprawl was land price. In Japan, there are four kind of land prices officially used. They are
Price of land announced in accordance with Public Notice of Land Prices Act (surveyed every year epoch; Jan. 1),
Price of land surveyed by local government according to National Land Use Planning Act (surveyed every year, epoch July 1),

A Concept of Land Administration Tool against City Sprawl (8769)
Yoko Horie, Saya Kobayashi and Masaru Kaidzu (Japan)

FIG Working Week 2017
Surveying the world of tomorrow - From digitalisation to augmented reality
Helsinki, Finland, May 29–June 2, 2017

Price of land adjoining a major road used for immovable tax(surveyed every 3 years by municipalities),

Price of land adjoining a major road used for inheritance tax (surveyed every year by National Tax Agency in July).

They are available through network.

3.3 Census data

The census is a survey by Statistics Bureau, Ministry of Internal Affairs and Communications, roughly divided into a large scale survey every ten years beginning in 1920 and a simple survey of the middle year. Survey items are surveyed on 20 items in large scale survey, 17 items on simple survey, such as name, gender, date of birth etc. The results of the survey are subjected to certain statistical processing for privacy protection, and can be confirmed at the portal site of official statistics of Japan (e-Stat). In the portal site, in addition to the census, it is possible to confirm a wide range of survey results, such as demographics survey (by Ministry of Health, Labour and Welfare), agriculture and forestry censuses (by Ministry of Agriculture, Forestry and Fisheries), economic censuses (by Statistics Bureau, Ministry of Internal Affairs and Communications), and so on. These data are open to and can be downloaded municipality by municipality for each data set of survey.

e-Stat[<http://www.e-stat.go.jp/SG1/estat/eStatTopPortalE.do>]

3.4 Immovable tax

The information of immovable tax is corrected and managed by the municipality. Originally, the cadastral survey is to clarify the value of taxable assets. When cadastral survey is completed, the result of them is reflected to immovable tax ledgers, and based on it, immovable taxation maps and ledger are updated at the epoch of new year. Maps and ledger has contains location, shape, area, owner, and land use of parcel together with buildings and so on, however, it can be prevented from being accessed from public and only used taxation purposes.

3.5 Resident registration

Municipalities trace move in and out of people though resident registrations. The data is announced through network monthly with standard format throughout the country. Census data is a quite reliable but it is surveyed only every 5 years. Thus, this data is quite useful to trace short term demographic movement. Of course, to protect privacy, the data is averaged over several blocks.

3.6 NSDI

The geospatial information is being developed for various purposes by various stakeholders including the national government, local governments and so on. The NSDI is maintained mainly by the Geospatial Information Authority and is provided as vector data through network for public use, so that these maps can refer to same coordinates and used widely under the same standard. Data items contained the NSDI are 10 items such as roads, railroads, rivers, the administrative community, and public facilities.

A Concept of Land Administration Tool against City Sprawl (8769)
Yoko Horie, Saya Kobayashi and Masaru Kaidzu (Japan)

FIG Working Week 2017

Surveying the world of tomorrow - From digitalisation to augmented reality
Helsinki, Finland, May 29–June 2, 2017

Selection and creation of proper index itself will be important point in research of city planning. For administrators, well known standard index will be necessary to communicate with residents, politician and other stake holders. Those indexes should be combined in simple way to form indicator suggesting future trend.

Feasibility of new residential area

Economic impact on agricultural productivity

Sustainability of residential area

Cost of maintenance of infrastructure per capita (Cost of clearing snow in winter time included)

Expected vacant land/dwelling after 10 years

Others

4. CONCLUSION

We designed a small prototype of GIS tool to help municipalities or communities consider city plan for sustainable future under declining population. Spatial distribution of some indicator will help city planner to communicate with community member and administrator to reach better understanding of the situation. This tool is still in infant phase. We are going to discuss with those people working on this field to make this tool available and reliable for them.

REFERENCES

- Sidentop, S., S.Fina (2008): Urban Sprawl beyond Growth: from a Growth to a Decline Perspective on the Cost of Sprawl ISOCRIP Congress 2008
- Schultink, G., (2009): Land Use Planning and Open Space Preservation: Economic Impacts of Low-Density Urbanization and Urban Sprawl Journal of Civil Environmental, and Architectural Engineering Vol.3
- Resnik,D.B.,(2010): Urban Sprawl, Smart Growth, and Deliberative Democracy, American Journal of Public Health Volume 100, No.10
- Oueslati,W,S. Alvanides,G.Garrod (2015): Determinants of urban sprawl in European cities, Urban Studies Volume 52, No.9
- EEA/FOEN(2016): Urban sprawl in Europe, EFA Report No.11/2016
- Muromachi, Y. (2003): How Is Urban Sprawl under Population Decrease Like?, 27th Infrastructure Planning and Management workshop (in Japanese)
- Kobayashi, H.,(2012): CHANGES OF CITIES FAMILIES AND HOUSINGS IN SHRINKING SOCIETY, Housing Research Foundation Research report No.39 (in Japanese)
- Tuchiya, S.,(2009): Study on “Rate of urbanization” in Japan, Bank of Japan Working Paper No. 09-J-4 (in Japanese)

BIOGRAPHICAL NOTES

Yoko Horie received the Master of Science degree from Tsukuba University, Ibaraki, Japan, in 2015. In the same year, employed by PASCO Corporation, Tokyo, Japan, and working in the department of asset management of municipalities. Present interests are on the policies on information asset management and system management for municipalities.

A Concept of Land Administration Tool against City Sprawl (8769)

Yoko Horie, Saya Kobayashi and Masaru Kaidzu (Japan)

FIG Working Week 2017

Surveying the world of tomorrow - From digitalisation to augmented reality

Helsinki, Finland, May 29–June 2, 2017

Saaya Kobayashi received the Master of Agriculture degree from Iwate University, Iwate Japan, in 2014. In the same year, employed by PASCO Corporation, and working in Land Information Department of Central Operations Division. Present topics of research are such as topographical mapping of Tokyo and improvement of agricultural ledger registry.

Masaru Kaidzu

1975 Graduate Nagoya Univ. (Physics)

1975-2017 Geographical Survey Institute, Ministry of Land, Infrastructure, Transport and Tourism, Japan (Geodesy, Crustal dynamics. Director of Geography and Crustal Dynamics Research Center when retired)

2017-2015 Japan Construction Information Center Foundation (Director, Department of GIS research, Director, System Engineering Department)

2015- PASCO Corporation (Geodesy, GIS. Chief Engineer Central Operations Department)

CONTACTS

Ms. Yoko Horie
PASCO Corporation
2-13-5 Higashiyama, Megro-ku,
Tokyo 153-8555
Japan
Tel. +81-3-6863-5525
Fax + 81-3-6863-5526
Email:
Web site:

Ms. Saaya Kobayashi
PASCO Corporation
2-13-5 Higashiyama, Megro-ku,
Tokyo 153-8555
Japan
Tel. +81-3-6863-5525
Fax + 81-3-6863-5526
Email:

Mr. Masaru Kaidzu
PASCO Corporation
2-13-5 Higashiyama, Megro-ku,
Tokyo 153-8555
Japan
Tel. +81-3-6863-5525
Fax + 81-3-6863-5526
Email: muazsa6361@pasco.co.jp

A Concept of Land Administration Tool against City Sprawl (8769)
Yoko Horie, Saaya Kobayashi and Masaru Kaidzu (Japan)

FIG Working Week 2017

Surveying the world of tomorrow - From digitalisation to augmented reality
Helsinki, Finland, May 29–June 2, 2017