Impact of Decreasing Birthrate and Aging Society on the Residents' Quality of Life in Large Metropolitan Areas

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***ABSTRACT*:** This study proposes a method for examining the impact of population aging and decline on quality of life. The method evaluates quality of life by considering individual preferences. This is associated with individual attributes such as gender and age. And the components, which are influenced by change in population, such as accessibility, amenity and safety&security, are included to measure quality of life. Applying the proposed method to the case city (Nagoya city, Aichi prefecture) shows that the impacts of the population decline on individual quality of life is higher than that of the population aging.

KEYWORDS: population aging and decline, quality of life, urban sprawl

1. INTORDUCTION

The population aging and decline have progressed rapidly in Japan. Despite the fact that the total fertility rate (TFR) must be more than 2.7 to keep population for long periods, TFR came down to 1.26 in 2005. According to the result of the medium variant projection, the total population in Japan is predicted to decrease by 12,544 thousands from 2005 to 2030. The proportion of elderly population to total population is predicted to increase from 20.2 % in 2004 to 31.8 % in 2030 (National Institute of Population and Social Security Research, 2000). Therefore, there has been is concern that the supply of administrative services decreases due to the increase of tax revenue and economic deterioration in this context.

Population and economic growth in Japan have contributed to the problem of urban sprawl of built-up areas. In the period of the population aging and decline, the administrative operation has not controlled the sprawl of built-up areas. This needs to be altered because large-scale public investment is hardly possible due to the financial constraint, and unless there are adequate polices, residential quality of life will obviously worse in suburban areas.

Therefore, this study aims at grasping the impact of population aging and decline on quality of life in residential areas quantitatively in order to clarify the way/direction of relocating residential areas to improve residential quality of life considering population aging and decline from long term perspective.

2. EVALUATION METHOD

2.1. Overall structure

Figure1 presents the overall structure for examining the impact of population aging and decline on quality of life.

First, the individual quality of life is calculated considering individual preferences and the attributes of each residence. The individual preference depends on individual attributes which are age, gender, occupation, household type, income level, etc.. And

this study focuses on age and gender as individual attributes which influence on individual preference. The attributes of each residence depends on the distribution of the urban facilities, transport network, and geographical conditions. These are described as Life Prospects (LPs) in this study.

Next, multiplying individual quality of life by the current and future population composition gives the current and future total quality of life measures. Therefore, this framework enables to examine the variations in the total quality of life associated with population aging and decline.

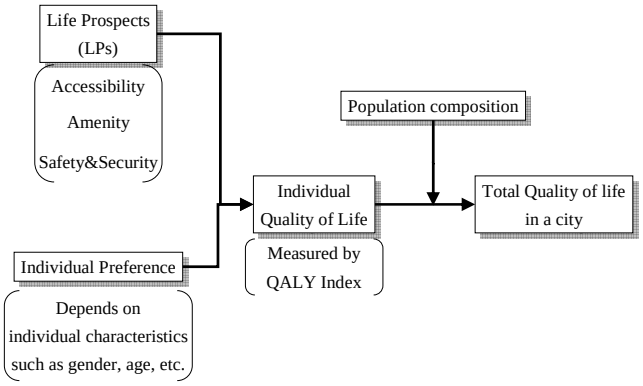

Figure1 overall structure of the proposed method for examining the impact of population aging and decline on quality of life

2.2. Estimation process of quality of life

The method proposed by Kachi et al. (2006) is applied to the evaluation of quality of life in residential areas. The characteristics of this method are as follows:

1) To consider the difference in individual preference depending on individual attributes such as gender and age.
2) This method can examine the impact of population aging and decline on the total quality of life in a target city.
3) Quality Adjusted Life Year (QALY) index is used as the quantitative measure for calculating quality of life. And life year is one of absolute values.
4) This method can calculate quality of life in the spatial detail area (500m*500m grid size).

In this method, quality of life is defined to consist of the main three categories which are accessibility (AC), amenity (AM), and safety&security (SS). Additionally, each category has four components respectively. These components and their quantitative measures are shown in Table1. The multiplying these components by individual preference gives individual quality of life in residential areas.

Table1 LPs hierarchical structure and the quantitative measures for components.

Main categories components	Quantitative measures
Accessibility	
Employment opportunity	Potential-type accessibility to offices (attractiveness: the number of labor)
Educational & cultural opportunity	Potential-type accessibility to libraries (attractiveness: the number of book stock)
Healthcare opportunity	Potential-type accessibility to hospitals (attractiveness: the number of bed)
Shopping & service opportunity	Potential-type accessibility to large-scale retail stores (attractiveness: gross floor space)
Amenity	
Living space	Gross floor space per person
Town-scape	Standard deviation of buildings' height
Green space	Green space per person
Local environmental load	Environmental noise level
Safety&Security	
Earthquake risk	Loss of life expectancy caused by assumed earthquake
Flood risk	Expected depth of assumed flood
Crime risk	The number of grab crime per year
Traffic accident risk	The number of injury accident pre year

2.3. Estimation method of future population

The future population in each zone is estimated by the cohort method provided by National Institute of Population and Social Security Research. The administrative district is used as zone in this study.

3. CASE STUDY

The population of case study area, Nagoya city is about 2.2 million, and its area is about 330 km^2. To analyze by 4^{th} mesh zone of about 500m*500m grid size, LPs components (the components of quality of life) are aggregated by 4^{th} mesh zone, and the estimated future population by the administrative district is allocated to 4^{th} mesh zones according to the assumption that the proportion among different 4^{th} mesh zones' population is constant.

The fertility rate and net migration rate from 1995 to 2000 in the City of Nagoya are used as the parameters for estimating the future population. According to this assumption, the future population by 5-year age group is estimated for each decade from 2000 to 2030.

3.1. Estimation of life prospects parameters

The individual preferences are explored by conducting questionnaire survey in the City of Iida, Nagano prefecture in 2004. Table 2 summarized the quality of life survey individual weights put on LPs components are estimated by conjoint analysis.

The results representing individual preferences are shown in Figure2. For the all components, the life year corresponding values decrease from 20's to 50's, and increase from 60's to 70's.

As for the components of accessibility, the life year corresponding values of all components are large in 20's, of which the scope of activity is wide, and decrease from 30's to 50's, and is large in 60's and 70's, which include a lot of mobility handicapped people. The corresponding values of healthcare and shopping & services are large in 60's and 70's.

For the components of amenity, the life year corresponding values of living space and local environmental load are large among the young. On the contrary, the corresponding values of town-scape and green space are large in older ages.

As for the components of safety & security, the pattern is different between male and female. The life year corresponding value of flood risk is large in males, but the life year corresponding value of earthquake is large in females.

Table2 general description of questionnaire survey

Item	Content
Content of questionnaire	Ranking of alternatives, individual attribute
Period	December, 2004
Respondents	Iida City's Officers and their family (age: teens to seventies)
Distribution and collection method	Internal post for Iida City Office
Number of distributed and collected questionnaire sheets	500/258

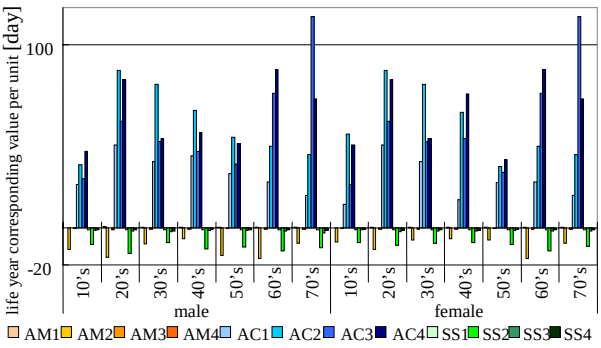

Figure2 estimated weights of each LPs component (life year corresponding value per unit)

3.2. Estimation of quality adjusted life years

The individual quality of life for each zone can be measured by using LPs components' estimated separately in each zone and individual weights of each LPs component shown in Figure2. Figure3 shows spatial distribution of estimated quality of life per person.

The quality of life per person is small in the areas where earthquake and flood risk is high. The areas located in the southeastern portion of case study city have higher quality of life per person than other areas. This is consistent with the fact that population has migrated from the city center to the southeastern portion in Nagoya city. This suggests the further progress of residential suburban sprawl. Therefore, the components of amenity and safety&security in the city center need to be improved to block the residential suburban sprawl.

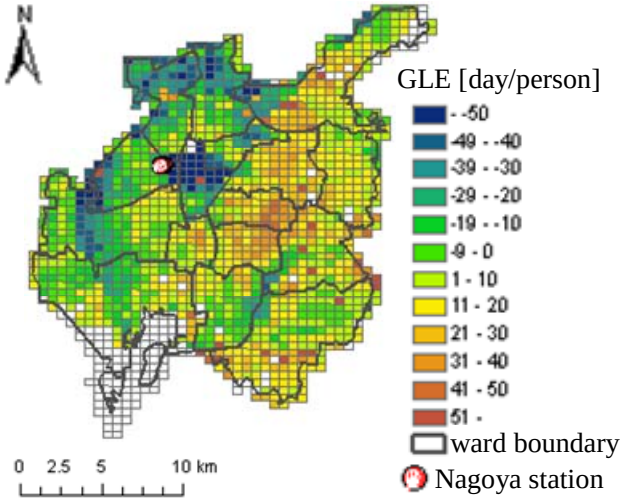

Figure3 estimated quality of life per person

The estimated quality of life per person in each ward is given in Figure4, where quality of life per person is represented by colors. The quality of life in Naka ward is highly negative than other wards because of the much lower safety&security. Tenpaku ward with highest quality of life only has positive amenity value. The result, that the composition of LPs components (accessibility, amenity, safety&security) depends on each ward, suggests that the policies suitable for each ward's current situation are needed.

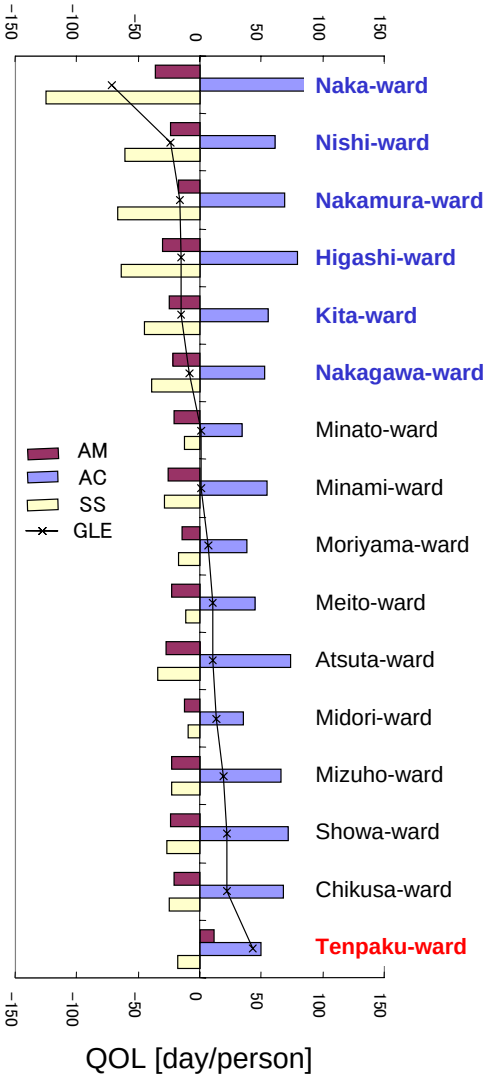

Figure4 mean of quality of life in each ward

3.3. Comparison of quality of life with population and land price

In this section, the relationship among quality of life, population and land price is given in Figure5, where quality of life is represented by colors; the height indicates population and land price.

Quality of life is higher in Area A, whereas a lot of population is not necessarily concentrated into Area A, comparing with other areas. On the contrary, the areas with lower quality of life accommodate more

population than the areas with higher quality of life. To summarize for the whole city, the spatial distribution of quality of life is not consistent with the population distribution.

Secondly, the relationship between quality of life and land price is examined. The Area C with lower quality of life is a central commercial district and its land price is about 20 times by that of the other areas. Although this is an extreme example, the spatial distribution of quality of life is not consistent to that of land price in the whole city.

The results prove that there is not distinct correlation between quality of life, population and land price.

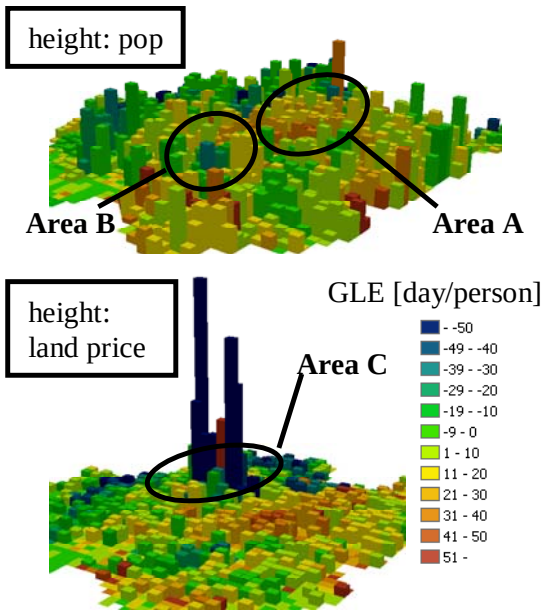

Figure5 comparison of quality of life with population and land price

3.4. Quality of life variations among different age groups

Given the purpose of exploring the aging society the quality of life variations among different age groups are demonstrated in Figure6.

The quality of life for 20's is higher than for 60's in Area D, where accessibility is higher than the suburban areas, and the amenity and safety&security is better than the central areas. Similar results are also valid for other areas with better accessibility and safety&security.

The quality of life of 20's is higher than that of 60's in the areas similar to Area D. On the contrary, the quality of life of 60's is higher than that of 20's in Area E, where amenity is higher than that of other areas. This kind of areas are scattered in the suburban areas and provide higher quality of life for 60's. For the whole city, the quality of life for 60's is lower in the areas with higher earthquake and flood risk.

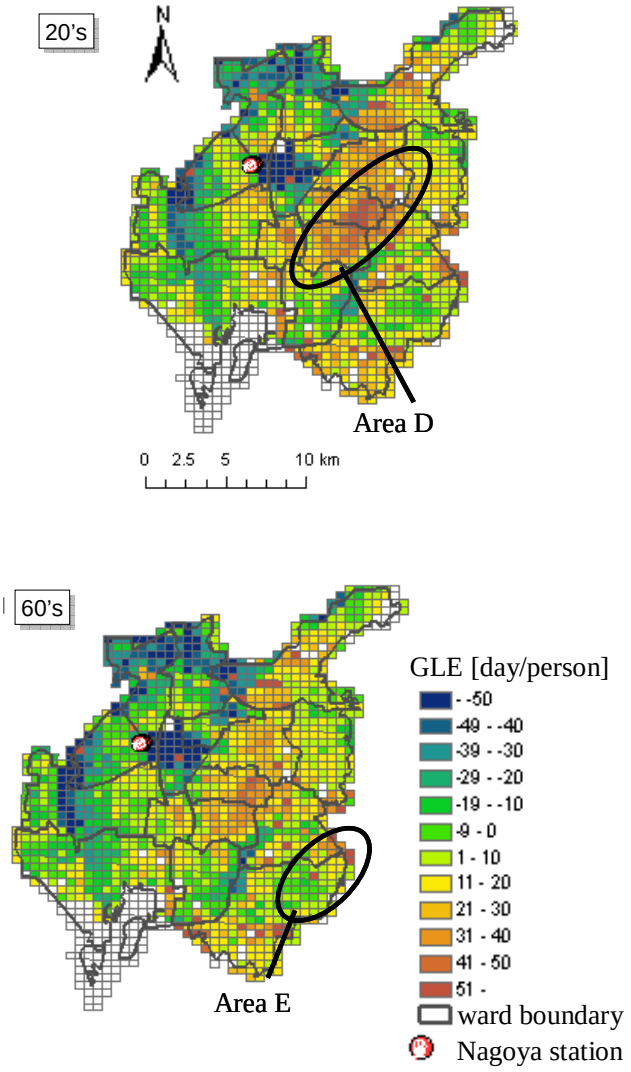

Figure6 quality of life for different age groups

3.5. Impacts of population aging and decline

The impacts of population aging and decline on quality of life is further examined by multiplying individual quality of life, is estimated for each individual attributes (gender and age), by the current and estimated future population composition.

Expected population density changes from 2000 to 2030 in the case study area implies that a remarkable decrease in a number of areas. The highly populated center shifts to the southeastern portion.

Despite a decrease in most of the areas between 2000 and 2030, any Midori-ward located in the southeastern portion accommodates more population. In addition, the share of the aged population tends to increase in the whole any areas. This may be distributed the fact that there has been considerable housing development from 1970 to 1990.

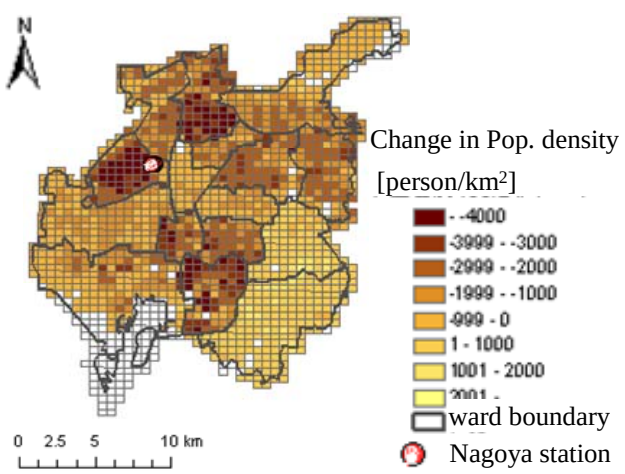

Figure7 change in population density from 2000 to 2030

The change in the average of quality of life and its composition is shown in Figure8. According to this figure, quality of life increases from 2000 to 2030. Examining the change of its components shows that accessibility and safety&security remain almost the same, where as, amenity increases. Indicating that the change of quality of life mainly depends on the value of amenity.

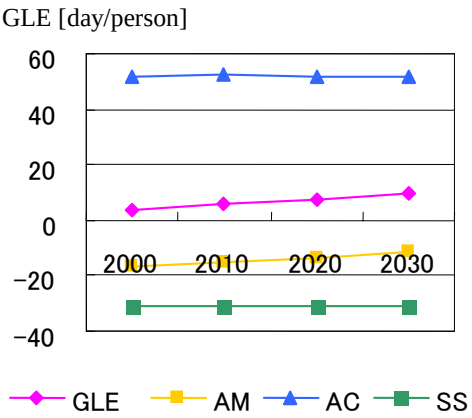

Figure8 change in the average quality of life in the whole case study area

The change in quality of life from 2000 to 2030 is shown in Figure9.

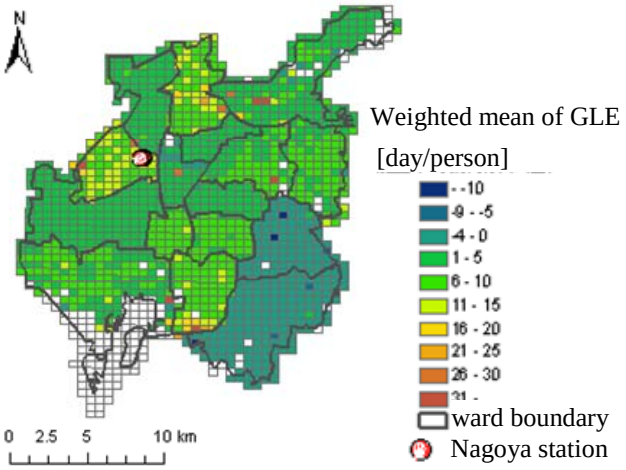

Figure9 change in quality of life from 2000 to 2030

According to this figure, the quality of life in the southeastern portion decreases due to the population inflow. On the other hand, the quality of life in the northwestern portion increases due to the population outflow. The main reason of the change in quality of life depends on the change in amenity due to the demographic shift. And change in individual preference due to the demographic shift less affects on quality of life than population decline.

4. CONCLUSIONS

This study proposes a method for examining the impacts of population aging and decline on quality of life, and applies to a real city (Nagoya city, Aichi prefecture). In conclusion, (1) the quality of life in the suburban areas is higher than that of the central areas as of today, and this may lead to the further residential suburban sprawl (the progress of suburban residential location); (2) the residence which can provide high quality of life to younger generation tends to be located in the central areas and the residence which can provide high quality of life to elderly people tends to be located in the suburban areas; (3) the impact of the population decline on the mean of quality of life per person is higher than that of the population aging.

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