A DETAILED SPATIAL CLUSTER ANALYSIS TO FINDING DISTRIBUTION PATTERNS OF LONGEVITY POPULATION USING DASYMETRIC MAPPING METHOD

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ABSTRACT: The majority cases of spatial analysis for the distribution of longevity population adopt census administrative boundary data. This approach is based on the assumption that Longevity Population is equally distributed throughout each administrative boundary unit. However, the census administrative boundaries which are artificially compartmentalized cannot reflect realistic characteristic of human residence and sensitive to Modifiable Areal Unit Problem (MAUP). Therefore, realistic and detailed set of spatial units is required when performing analysis for distribution of longevity population. The dasymetric mapping method enables to product more detailed and realistic than census boundary map for distribution of longevity population map utilizing diversity spatial information. Furthermore, cluster analysis enables to grasp the distribution of longevity population which considered spatial association.

This study proposed a combined process of dasymetric mapping and cluster analysis to improve the spatial accuracy for distribution of longevity population. The dasymetric mapping method could be provided the boundary revision adopt Land-cover data and residential information with 2007 census data in Gangwon province, Korea. The cluster analysis was performed to find the Hot spot (or Cold spot) of Longevity Population distribution. The dasymetric map confirmed the new boundary which had characteristic of human residential distribution. And more clusters discovered with statistical significant than existing boundary data (such as census administrative sub-level data).

1. INTRODUCTION

The research field on human longevity has been growing with GIS spatial analysis Technique. Because the derived information could be provide such as distribution of longevity population and regional influencing factors by GIS. However, the current study of longevity with spatial analysis has two problems. The majority cases of spatial analysis for human longevity has focusing to finding the distribution of longevity population and regional influencing factors that use to restrictive approach of spatial statistical information. Generally, spatial

analysis on human longevity adopts census administrative boundary data. This approach is based on the assumption that Longevity Population is equally distributed throughout each administrative boundary unit. However, the census administrative boundaries which is artificially compartmentalized cannot reflect realistic characteristic of human residence and sensitive to Modifiable Areal Unit Problem (MAUP)(Openshaw, 1983). This analysis may also cause residential areas that are considered non-resident. Based on these results, derived with regional cause and effect factors will be able to see the false information. Another problem is a selection of uniform spatial units. The analysis does not reflect the actual phenomenon that dependent on the possibility of statistical data collection, because there are a variety of spatial characteristics within the local area of census administrative boundaries. The results of these analysis methods can be the cause of regional policy that did not reflect regional characteristics. Therefore, realistic and detailed set of spatial units is required when performing analysis for distribution of longevity population. The dasymetric mapping method enables to product of spatial unit more realistic than census administrative boundary map and statistic estimates of small area utilizing diversity spatial information. The dasymetric mapping technique became famous by wright since 1936. Especially has been recognized for excellence that the researches on the subject of population density per regional of spatial deduct. Generally the dasymetric mapping has been recognized as a kind of areal interpolation methodology (Mennis, 2003). Also the dasymetric mapping is known that the most effective type of thematic maps to reproduce Patterns of the spatial distribution of socio-economic phenomena. Furthermore, cluster analysis enables to grasp the distribution of longevity population which considered spatial association. The purpose of this study is to create realistic spatial distribution map of distribution of longevity population. Also grasp the distribution of longevity population within local area of census administrative boundaries using cluster analysis.

2. STUDY AREA AND DATA

The study area is from 37°27'N to 37°54'N in latitude and from 129°04'E to 128°35'Ein longitude which is the Gang-neung census administrative in Gang-won province, Korea(Fig. 1). The total terrestrial area of Gang-neung census administrative is 1,039.82㎢.

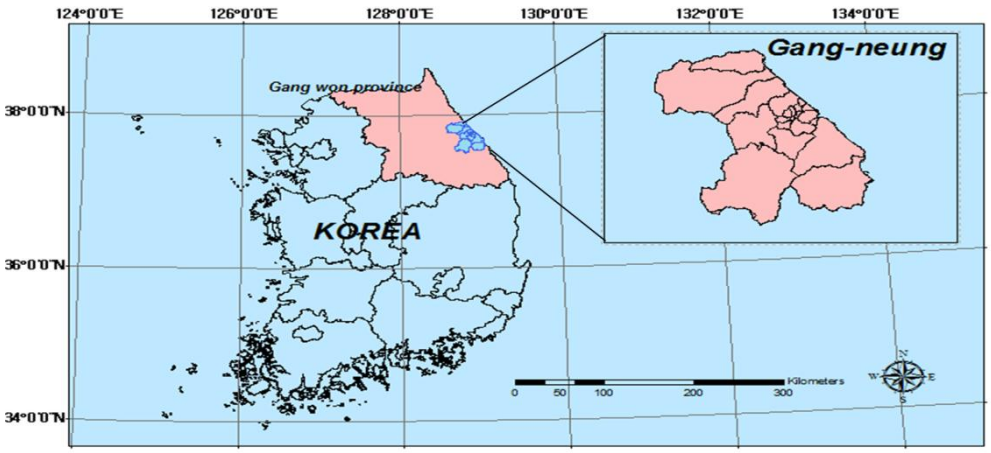

Fig. 1 Study area

The dasymetric mapping method could be provided the boundary revision adopt Land-cover data and residential

information with 2007 census demographic data. Residential information of Land cover data were used for Dasymetric map of longevity population distribution. And the small area boundary data used for cluster analysis that less than aggregated census administrative boundary data.

3. METHODOLOGY

3.1 Dasymetric mapping for distribution of longevity population

The longevity index used in this study, Eq. 1 (Kim, 2005).

$$\text{Longevity Index} = \frac{Over\ 80\ population}{Over\ 65\ population} \times 100(\%) \qquad (1)$$

Residential information of Land cover data were used for the dasymetric map of longevity population distribution and 3-class areal interpolation method was used for allocate longevity population to each of the residential area. 3-class interpolation method assumes that human lives in urban areas, agricultural areas, forest areas. Also urban areas, 0.7, 0.2 agricultural areas, forest regional are given a weight of 0.1 that assumed population distribution is different by each land use(Brewer, 2001). The dasymetric process is Eq. 2.

$$D_i = \frac{P_i W_i S_i}{\sum_{n=1}^{n} W_i S_i} \qquad (2)$$

D_i is the estimate of elderly sub-area I, P_i is statistics of census area i and W_i is weight of each land use . S_i is the overlapping area between census boundary and sub-areal unit. The number of spatial boundary data is n.

3.2 cluster analysis for small area

The census administrative boundaries which were artificially compartmentalized cannot reflect realistic characteristic of human residence. Therefore, cluster analysis required to find the variation of local spatial relationship. The cluster analysis calculated by $\text{Getis} - \text{Ord Gi}^*$ as Eq. 3. $\boldsymbol{Gi}^*$ shows the concentration of high value and low value through calculate the z-score(statistically significant degree) within spatial object of regional. $\boldsymbol{Gi}^*$ of statistically significant positive value means that the "Hot spot" exists around the reference regional and negative value means that the "Cold spot" exists around the reference regional.

$$\mathbf{I} = \frac{\boldsymbol{n}}{\boldsymbol{S_0}} \frac{\sum_{j=1}^{n} \quad \sum_{j=1}^{n} \quad \boldsymbol{W_{ij} z_i z_j}}{\sum_{j=1}^{n} \boldsymbol{z_i^2}} \qquad (\mathbf{3})$$

$\boldsymbol{z_i}$ is the deviation of attribute from regional I, $\boldsymbol{W_{ij}}$ is the spatial weighted matrix between regional i, j, and n is the number of regional.

4. RESULT

Fig. 2 is the choropleth map of distribution of longevity population based on census administrative boundary. The choropleth map shows that the longevity population is equally distributed throughout each administrative boundary unit through same color. On the other hand, Fig. 3 using the dasymetric mapping method shows that detailed representation of spatial density of longevity population.

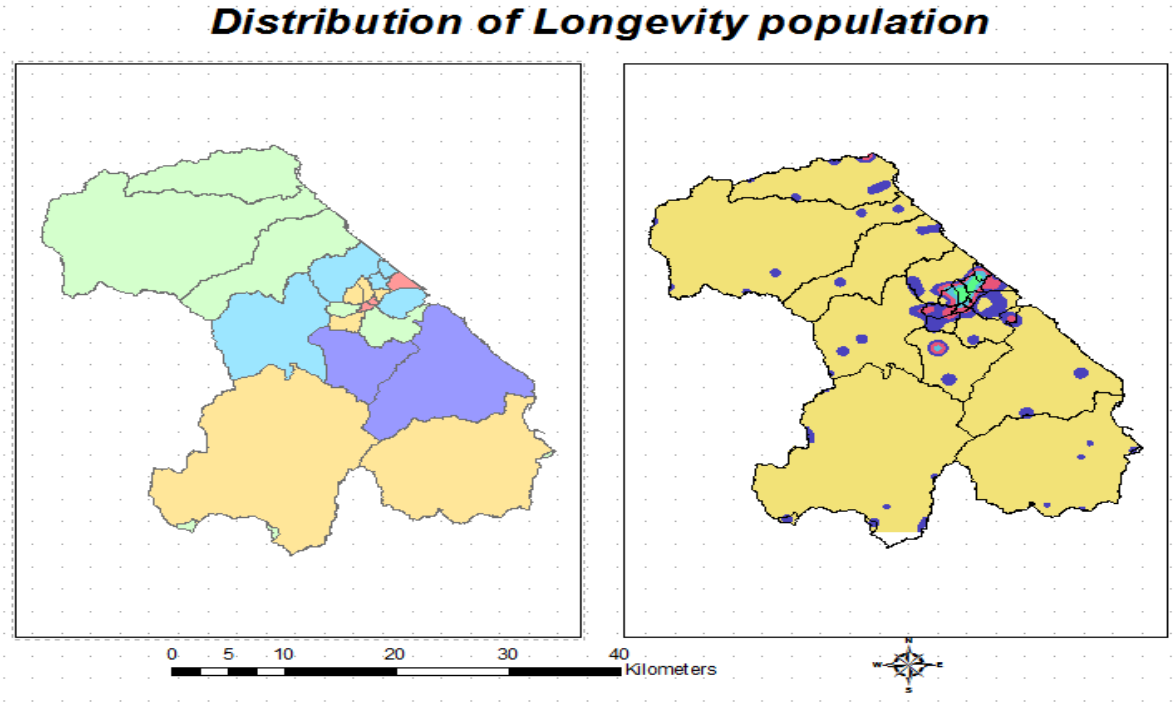

Fig. 2 Choropleth map **Fig. 3 Dasymetric map**

The dasymetric map also shows that the regional include considerable non-residential area which was high density of longevity population based on census boundary. The variation of local spatial relationship was confirmed within census administrative boundary when reference the dasymetric map of distribution of longevity population. Therefore, identifying is required that the variation of spatial relationships which occur in local areas. Fig. 4 is the map based on census administrative boundary level. Most of the area shows that the non-significant result of statistical. The result caused that the spatial relationship was not reflect when the spatial aggregation is higher. The result of $\boldsymbol{Getis-Ord\ Gi^*}$(Fig. 5) shows that the "Hot spot" and the "Cold spot" of longevity population clustered flowing south coast. The result of cluster analysis shows that calculated 99% confidence interval. And the "Hotspot" and the "Cold spot" are showing that in the "statistically significant level". It means the cluster analysis confirmed that the variation of local spatial relationship within census administrative boundary.

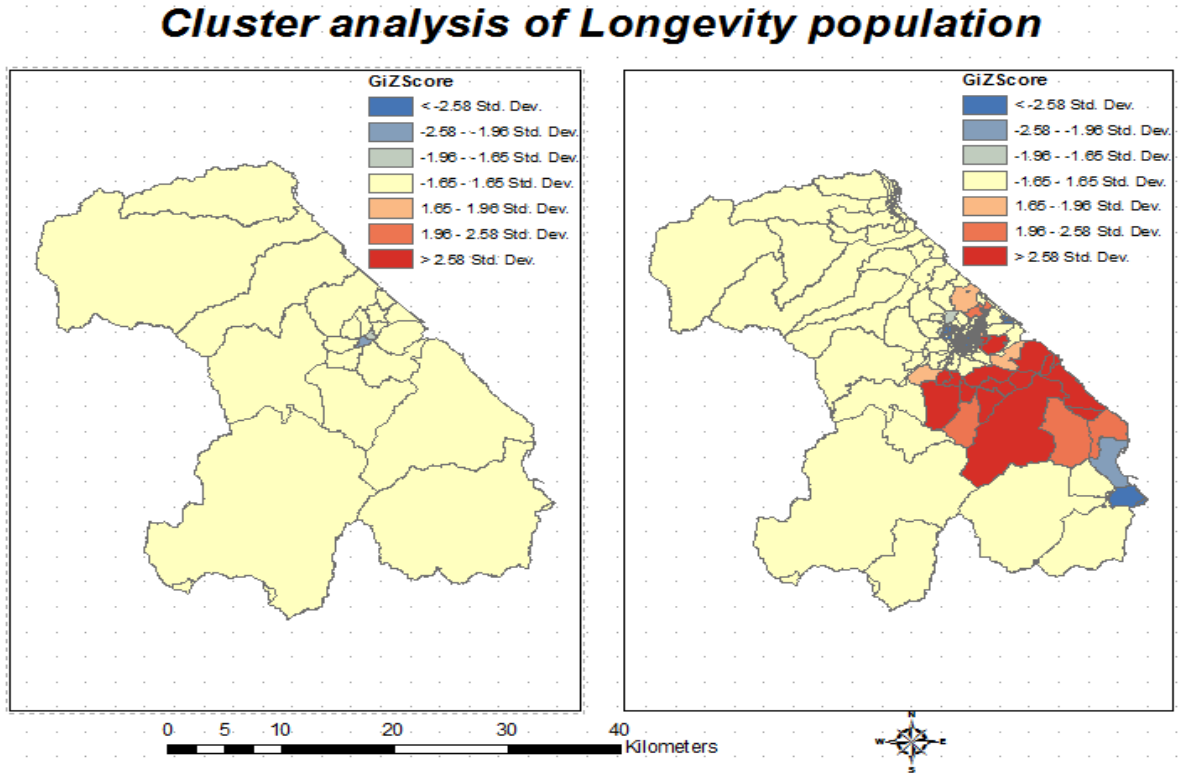

Fig. 4 Census boundary **Fig. 5 Small area**

5. DISCUSSION

In this study, the spatial distribution map of longevity population was created using dasymetric mapping method. Also grasp the distribution of longevity population within local area of census administrative boundaries using cluster analysis. The result of this study implied that the need for local-level studies of the human longevity and the validity of the dasymetric mapping techniques.

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