Spatial Distribution of Population in Colombo Metropolitan Area

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Introduction

Population distribution pattern is one of the vital factors needed to take decisions related to urban planning, which helps to develop physical plans and the form of urban development policies.It is important to analyse people according to the places where they live in. An accurately analysed urban population distribution pattern shows how to spread out people within the urban spatial structure and it provides a proper platform for decision making in urban planning (Luo, 2005; Clark,1951). Geodemography provides an analytical overview to analyse this situation. Census units are arbitrary boundaries and visualization of population data in this platform does not provide a real ground picture. The new era of electronic data, the internet, and GIS, geospatial tools have removed the limitations of printed reports and standard administrative boundaries. As a result, geodemography has come out as a subject to minimise limitations of visualizing aggregate census data. Geodemography is a subject which the studies people based on their lives linked in a multidisciplinary manner (Paul,2012. It connects with the discipline of demography (the study of human population dynamics) with geography (the study of the locational and spatial variation of both physical and human phenomena on Earth), and also sociology. Also, geodemography has a better relationship between demographic data and spatial location. This is conceptually challenging for spatial representation as well as to organize, manage and analyse geospatial information with location attribute and time. It is also a combination of GIScience and geocomputation(Abrahart and Openshaw 2000; Goodchild, M.F., 2010).

Particular geodemographic tools make data access easier and more end-users can easily access the information they need. In urban land use analysis, planners have been facing the challenge of integrating, aggregate census data with disaggregate land-use data. However, present GIS technologies provided some opportunities to minimize the above issue. But restriction of aggregate census data with boundary definitions suffers various analytical problems. First, Modifiable Areal Unit problem (MAUP) is one of the main analytical problems associated with the use of data aggregated to geographical areas (Gehlke and Biehl,1934); Openshaw ,1984; Fotheringham and Wong,1991). Second issue is, integration of aggregate census data with disaggregate land use data. The population distribution is usually displayed homogeneously on a census unit, which misrepresents the population variations (Jan, 2006; Bracken,1993; Bracken and Martin, 1989). Thirdly, influences of non residential land uses in defining urban densities force great impact to misinterpret real densities (Ingram, 1998) During last two decades, most GIS researchers have attempted to use surface modeling to represent the spatial distribution of population such as featured neighbourhoods (Harris,et.al,2005; Martin, 1998) Analyse urban spatial structure (Luo, 2005) etc.

Hence, this paper attempts to develop some methodologies to explore spatial distribution pattern of population during the last decade of the Colombo Metropolitan Region using surface modeling techniques.

Objectives of the Study

The aim of this study is to analyse spatial distribution of urban population in Colombo Metropolitan Region during the last decade. To accomplish this main objective some specific objectives have been developed as follows;

- To analyse urban population distribution by applying techniques of surface models in GIS.
- To develop some methodologies for avoid MAUP.

Study Area

The Colombo Metropolitan Region (CMR) has been selected as the study area, which accounts 28.8% of total population in Sri Lanka. It consist of 11.5% Colombo, 11.3% Gampaha, 6% Kalutara and the whole contains more than ¼ th of total population in the country. The study area covers approximately 3745 sq.km. and it consists of 2497 GN divisions. 1:10000 GN boundary map and1:50000 topographic map haven been used to assign population data.

Methodology of the study

The methodology aims to mitigate MAUP and study concerns only residential land uses to calculate population density of sub districts (GN Divisions). Following formula is used for that.

$$\sum_{ji}^{i} \frac{GND\ population}{Total\ area j\ -\ non\ residential\ area j}$$

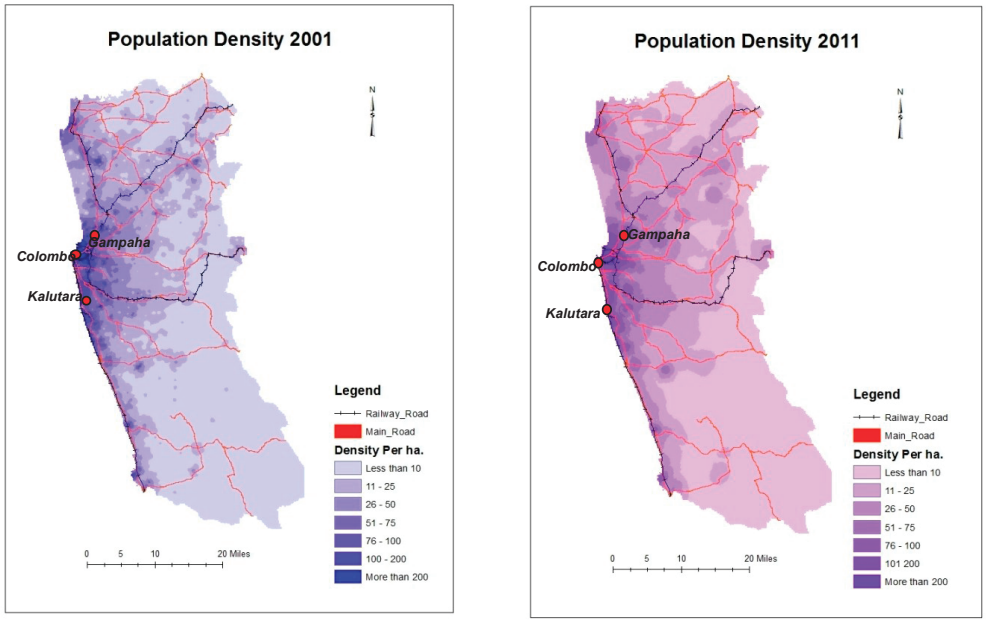
Secondly GND centorids were created and population density was assigned to centorids. It was then converted to 100×100 raster map. In this case non residential grid was omitted and 0 value was assigned to non residential grids. This approach facilitates to minimize the modifiable areal unit problem and improve the accuracy of census population disaggregation. Spatial interpolation in ArcGIS 10 was used for generating population surface. Following table 1 shows a summary of Statistics of Population in GNDs

Table 1: Summery Statistics

	GND	Maximum	Minimum	Mean	Stranded Deviation
Total population	2497	27309	143	2147	2175
Population	2497	54149	4	3036	4930
Built-up Area (Ha)	2497	6.92	0	0.57	0.54
Non Built-up Area	2497	31.85	0	1.2	1.67

Based on the above 2497 GND's in the CMR, population surface was developed and figure 1 indicates the population density distribution pattern among CMR.

Figure 2. Population Density surface 2001 and 2011



When comparing the population distribution in the whole CMR majority of the area shows population densities less than 10 persons per ha. Figure 2 highlighted most significant points regarding the spatial distribution of the population in the CMR. (1) High population densities concentrated among three major cities. (2) Average population densities are concentrated near main roads and small town centers.. Density of more than 200 per ha comprises an area in close proximity to the City of Colombo. Within 20 km meters from the city of Colombo population concentration is high and other areas show a moderate picture. But along main roads connected with other main strategic locations in the country, high population densities are seen compared to other areas. It shows an expectation of accessibility to main cities.

Conclusion

The new research agenda in geodemography with GIS faces some problems in MAUP about spatial association with census data. This study adapts a simple rationalisation methodology to aggregate census data with spatial data to explore the spatial distribution of population. This method is specifically developed due to some data limitations common in the developing countries. However it can be developed in a more advanced way with availability of

data. But this study shows its use with certain data limitations in a developing country's perspective.

Key words: Geodemography; GIS; Population Surface; Spatial Interpolation

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