The influence of urban development and social mobility on socioeconomic level: The application of GIS on urban ecosystems

Nur Suhaili Mansor *, Helmi Zulhaidi Mohd Shafri, Shattri Mansor, Biswajeet Paradhan
Civil Engineering Department, Faculty of Engineering, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

*E-mail. nursuhailimansor@gmail.com (Corresponding author)

Abstract. Specifically, the integration between social sciences and natural science are fundamental in our understanding of the economic, social and technological transformations that have drastically changed the society. This study will be based on the municipality of Sungai Petani, Kedah as it has been most influenced by urbanization and urban development. Urban development in Sungai Petani is closely associated with a tremendous increase in demand for land, which is highly related to population growth, human movement and their social mobility. The qualitative case study taken will rely on the visual interpretation technique that would allow the researcher to develop a map of urban changes detection. The potential application of GIS information to estimate socioeconomic indicators and the modelling of socio-economic activities that are explored in this study is hoped to increase further our understanding of the impacts of development and urbanization on social life.

1. Introduction
Nowadays, urbanization on land uses had been increasingly subjected to changes of different forms, sorts and types since the urban explosion of the 1970s that effected on environmental [1]. Most people moved to cities from rural area who expected to get benefit from the urban economy to improve social life. Mobility of the people typically moves to urban areas in search of economic opportunities. This phenomenon is particularly significant in developing countries, where rural poverty and the rural-urban income gap are worrying aspects for development. Therefore, the agriculture sector has been greatly modified by human activity that gives more economic opportunities to the locals.

Since environmental changes are going on in association with changing patterns of economy, society, culture and civilization. Multifaceted changes, transformation and conversions are the results of multilevel pressures on ecosystems and the human dimensions of global environmental changes happen through a subset of multilevel driving forces which directly or indirectly alter aspects of the physical, economic, social and cultural environment in ways that have global as well as regional effects.

Typically, in Malaysia, development of the urban for the last two decades due to industrialization, an increase in economic prosperity and urban population has opened opportunities for new developments in urban areas and their periphery. This growth has significantly changed the landscape of many cities. In the context of urbanization, a large amount of agricultural land has been converted to built-up or urban land uses. The dynamics of urban landscape systems of Malaysian cities are driven by complex political, social and economic systems [2].
From the above literature, this is an exciting research area is emerging around the integration of detailed social and spatial networks that expect that upcoming cohort of demographers will increasingly utilize new forms of geospatial data and analyze those using spatially explicit methods [3]. Also, clearly the research that applied remote sensing information and GIS application on the social mobility and socioeconomic research that link them to the economy, and the urban ecosystem is very limited in Malaysia. There is some similar research on social and economic such as, cultural factors are evident in mobility patterns, even when many economic and social factors are controlled [4]. It is also clear that much has been done to analysis aimed at improving the Malaysia social wellbeing through a related study done by previous research which analysis of social, economic, and political changes that took place between 1966 and 1978 in the rural Malay community.

Further to improving Malaysian social mobility and their socioeconomic, various studies show that lack of study about related land use and social mobility, also the lack of study, which uses GIS and remote sensing to see this relationship. In levels within a developing country, i.e. Malaysia needs a study about a social mobility concept to ensure continuation of stability and development across the country, especially in Sungai Petani. Therefore, it is to fill structural plan of Sungai Petani and implementation.

2. Data collection
This research will employ the survey research methodology by using primary and secondary data to map the land use and socioeconomic activity. Land use map will be generated from SPOT-5 covering the periods of 2000 and 2012 will be used to prepare land use maps and monitor the land use changes. For the change detection, time-series of images of SPOT-5 2000/2012 will be compared.

Then, use statistical reports, periodicals or annual for economic indicator reports and structure plan and household survey secondary data. The structure questionnaire will be distributed to the targeted respondents. Most especially farmers were asked about their activity related rubber plantation, paddy field, including the pattern of land use over the past years surrounding Sungai Petani. On the local stakeholders such as rubber plantation owner, private sector and district, administrative office such as district planning and investment office, district agriculture and forestry office will be interviewed.

3. Conceptual framework of study
In this research study, data preparation and pre-processing are a phase to achieve the objective of the study. The data preparation task is to see the change detection over a period; also a statistical analysis model for growth based on their population and socioeconomic indicators.

For satellite imagery should be used in each time, corresponding to two different periods of time. The adopted interpretation technique, which is preferred to the standard classification, is based on visual interpretation assisted by computer to see the change detection.

The process consists of displaying the rectified or registered imagery on the screen which representing different land use categories, based on image characteristics such as tone, texture, colour and pattern, which are translated into land use attributes.
3.1. Linking of urban ecosystem (RS) and GIS with social mobility

Selected socioeconomic characteristics may be extracted directly from remote sensor data or by using surrogate information derived from the imagery. Two of the most important attributes are a population and quality of life indicators [5]. Remote sensing techniques may provide a population estimate that approaches the accuracy of traditional census methods if sufficiently accurate in situ data are available to calibrate the remote sensing model.

The most accurate remote sensing method for estimating the population of a local area is to count individual dwelling units based on the following assumptions [6,7] (i) The imagery must be of a sufficient spatial resolution to identify individual structures, even though tree cover and whether they are residential, commercial, or industrial buildings; (ii) Some estimation of the average number of persons per dwelling unit must be available; (iii) Some estimate of the number of homeless, seasonal, and migratory workers are required; and (iv) It is assumed that all dwelling units are occupied, and that only n family lives in each unit (calibrated using in situ investigation).

Besides that, [8] that adequate income, decent housing, education and health services, and good physical environment are important indicators of social wellbeing and quality of life. Evaluating the quality of life of a population on a continuing basis is important because it helps planners and government agencies involved with the delivery of human services to be aware of problem areas. In the past, most quality of life studies made use of census data to extract socioeconomic indicators.

The previous research on the mobility experiences of very low-income families, expectation patterns of mobility among low income families that emphasize the role of personal safety nets in searching for and securing housing, instability (that is, frequent moves), and a prevalence of informal housing solutions. These factors produce mobility dynamics that are mostly independent of neighborhood concerns. Therefore, several more attempts have been made to use GIS for measurements and analysis of individual mobility under special space, time constraints [9].
There many current models of human activity are fundamentally stochastic from Erlang’s formula used in telephony to L’evy-walk models describing human mobility[10]. Gonzalez found out that, in contrast with the random trajectories predicted by the prevailing L’eyywalk models, human trajectories show a high degree of temporal and spatial regularity, each individual being characterized by a time-independent characteristic travel distance and a significant probability to return to a few highly frequented locations. Similarly, by measuring the entropy of each individual’s trajectory, [11] demonstrated that a 93% potential predictability in user mobility across the whole user base.

Indeed, linking GIS and RS with social movement has long been a critical issue [12]. GIS and RS are used in urban growth models as spatial data and link them to social mobility data as non-spatial data including questionnaires to provide functions such as data processing and visualization. The combination both data, spatial and non-spatial data will be processed in GIS software and to model them. The GIS and RS are mainly used for providing data inputs for the purpose built model program and for presenting the model results. It has been far easier to produce purpose built programs and special graphics and interface functions for the model than to embed these into the proprietary GIS software. The core model functions are implemented through mainstream statistic or computing software, including SPSS, SEM, and Matlab. GIS and RS have also been used mainly for data inputs and display of model results.

3.2. Socioeconomic level
Changes in land development are often associated with policy implementation and socioeconomic factors. The growing population or social mobility and the increasing socioeconomic necessities have created pressures on land use and land covers. Therefore, economic development strategies have focused on labor force training, business recruitment, and tax incentives, rather than seeking a better spatial arrangement of the socioeconomic activities within a region. Moreover, in many planning studies and models, the interactions have been considered for a ‘top down’ perspective without consideration of ‘bottom up’ connections; that is, regional economic growth and transformation are only assumed to have significant effects on land use and the spatial structure within the region.

Addition to that, it contributes to a more systematic coordination of economic development and land-use planning, which is essential for achieving a more complete realization of urban development that is ecologically and socio-economically sustainable and prosperous. Former researcher agreed that processes were based on the interrelationships between the social and ecological processes and notably how changes in the landscape induced changes in the community [13].

Figure 2 below represents the first attempt to identify land development and social mobility and their impacts in an urban setting also the development as well as some other factors in previous literature such as institution, geography, mobility and human capital are significant factors in current socioeconomic development rather than urban growth. Then, there exists an optimal secondary ratio to see the socioeconomic level status and social mobility.
4. Results and discussion

By applying an integrated framework, this paper has analyzed and compared the urban changes detection, which are expected to occur due to urbanization strategies in Sungai Petani. In the assessment acquire the data about the urban changes detection in Sungai Petani in 2000 and 2012 respectively (Figure 3), the accuracy assessment of urban change detection between 2000 (Table I) and 2012 (Table II). According to figure 3, the massive increase of urban area (including residential, industrial) and green area (including paddy field, dry land), and bare land (including transportation, land) and, forestland (including rubber estate) contributed to the main features of urban changes in Sungai Petani between 2000 and 2012. Moreover, the change amplitude of green area around urban area which include residential and industrial was significant, population year 2000 about 339,898 people and increase to 1,993,000 people year 2012 (source: Local Authority, 2013).
According to the results obtained, this process of modification of the land can improve the efficiency of the economy and the income level of the population. Although the indicators may not represent all the socioeconomic and environmental aspects of the problem at hand, they have been useful in order to highlight some important links between urbanization strategies and the agriculture change process in the area of study. It may be concluded that the most significant features of the change of urban development type in Sungai Petani between 2000 and 2012 were construction, land occupied, massive agricultural land, land-use type of agricultural land changed internally to that of relatively high economic benefits. Therefore, it is shown the economic opportunities and living conditions are the main reason the mobility occurred.

Table 1. Accuracy assessment for urban changes detection types year 2000.

| Reference Total | Classified Total | Number Correct | Producers Accuracy | Users Accuracy |
|-----------------|------------------|----------------|-------------------|---------------|
| Water bodies    | 10               | 10             | 9                 | 90.00%        | 90.00%        |
| Forest          | 42               | 40             | 39                | 92.86%        | 97.50%        |
| Bare land       | 13               | 16             | 12                | 92.31%        | 75.00%        |
| Green area      | 16               | 17             | 14                | 87.50%        | 82.35%        |
| Urban area      | 19               | 17             | 17                | 89.47%        | 100.00%       |

Kappa 97.35, Accuracy 98.00%

Table II. Accuracy assessment for urban changes detection types year 2012.

| Reference Total | Classified Total | Number Correct | Producers Accuracy | Users Accuracy |
|-----------------|------------------|----------------|-------------------|---------------|
| Water bodies    | 11               | 10             | 10                | 90.91%        | 100.00%       |
| Forest          | 31               | 31             | 30                | 96.77%        | 96.77%        |
| Bare land       | 11               | 11             | 11                | 100.00%       | 100.00%       |
| Green area      | 15               | 16             | 16                | 100.00%       | 93.75%        |
| Urban area      | 32               | 32             | 32                | 100.00%       | 100.00%       |

Kappa 87.87%, Accuracy 91.00%

5. Conclusion
In the social sciences, primary research themes span problems at local through global scales. They range from the sense of place associated with daily life to the interdependences associated with regional and global interconnections. They also reflect the needs for descriptive and predictive tools that enhance insights on the meanings of spatial patterns and how they relate to societal processes that impinge on all aspects of social wellbeing [14].

Using GIS as a method for modeling the urban development change observed against the environment with socioeconomic variables. In this research, the relation between science and social will produce the map of urban changes detection. This study attempts to embark on a science based social research that studies social wellbeing and the application of remote sensing and Geography Information Science (GIS). Specifically, the integration between social sciences and natural science are fundamental in our understanding of the economic, social and technological transformations that have drastically changed the society.
Acknowledgements

I would like to acknowledge to Assoc. Prof Dr. Helmi Zulhaidi Mohd, Prof Dr. Shafri Mansor and Assoc. Prof Dr. Biswajeet Parhadan for helpful discussion, I would also like to thank Mrs Suziyanna Arshad for Remote Sensing Agency. A special thanks also goes to the anonymous reviewers for their comments and suggestions that helped to improve an earlier version of this paper.

References

[1] G. Siciliono, “Urbanization strategies, rural development and land use changes in China: A multiple-level integrated assessment,” Land Use Policy 29, p165-178, 2011.
[2] M. N. Sharif and R. Ruslan, “Modelling Urban Spatial Structure Using Geographically Weighted Regression” At 18th World IMACS / MODSIM Congress, 2009.
[3] S. A. Matthews and D. M. Parker, “Progress in Spatial Demography,” Vol.28, page271-312. http://www.demographic-research.org/Volumes/Vol28/10, 2013.
[4] R. W. Johnson and J. Davanzo, “Economic and Cultural Influences On The Decision To Leave Home In Peninsular Malaysia,” Demography, 35(1), 97–114. Retrieved From Http://Www.Ncbi.Nlm.Nih.Gov/Pubmed/9512913, 1998.
[5] J. R. Jensen and D. C. Cowen, “Remote Sensing of Urban/Suburban Socio-economic Attributes,” Proceedings Land Satellite Information in the Next Decade II, American Society for Photogrammetry & Remote Sensing, Bethesda, Maryland, Compact Disk, 1997.
[6] C. P. Lo, “Automated Population and Dwelling Unit Estimation from High-Resolution Satellite Images: A GIS Approach;” International Journal of Remote Sensing, 16:17-34, 1995.
[7] B. Haack, S. Guptill, R. Holz, S. Jampoler, J. Jensen, and R. Welch, “Chapter 15: Urban Analysis and Planning,” Manual of Photographic Interpretation, American Society for Photogrammetry & Remote Sensing, Bethesda, Maryland, pp. 517-553, 1997.
[8] C. P. Lo and B. J. Faber, “Interpretation of Landsat Thematic Mapper and Census Data for Quality of Life Assessment,” Remote Sensing of Environment, in press, 1998.
[9] S. L. Shaw and H. Yu, “A GIS-based Time-geographic Approach of Studying Individual Activities and Interactions in A Hybrid Physical/ Virtual Space,” Journal of Transport Geography, 2009, vol. 17, pp.141-149, 2009.
[10] M. C. González, C. A. Hidalgo and A. L. Barabási, “Understanding individual human mobility patterns,” NATURE, vol.453, pp.779-782, 2008.
[11] C. Song, Z. Qu, N. Blumm and A. L. Barabási, “Limits of Predictability in Human Mobility,” Science. vol.327, no.1018, pp.1018-1021, 2010.
[12] M. J. Mlotha, “Remote Sensing And Gis Linked To Socio-Analysis For Land Cover Change Assessment,” 0-7803-7031-7/01/ 2001 IEEE, 2001.
[13] C. M. Raboanarielina, “The forgotten resource: Community perspectives on conservation and well - being in Zahamena National Park, Madagascar,” Madagascar Conservation & Development Volume 7 | Issue 2s — November 2012,2012.
[14] D. G. Janelle and M. F. Goodchild, “Concepts, Principles, Tools, and Challenges in Spatially Integrated Social Science,” The Sage Handbook Of GIS And Society Research, 2011.