



University Of Isfahan

Urban - Regional Studies and Research Journal
4th Year – No. 16 - Spring 2013
ISSN (online): 2252-0848
ISSN (Print): 2008-5354
<http://uijs.ui.ac.ir/urs>

Evaluating various criteria for determining diversity of urban Mixed Land Use via GIS (Case Study: neighborhoods and districts of Tehran Municipality No.7)

Gh. Javadi, M. Taleai, M. Karimi

Received: March 02, 2012/ Accepted: August 12, 2012, 7-12 P

Extended abstract

1-Introduction

Methods of zoning and land use allocation are experienced in the history of urbanism and its weak and strong points are clearly investigated. In spite of some advantages, this kind of spatial planning has its own disadvantages. New ideas of urbanism support the viewpoint of mixed land use and consider it as the key element for urban sustainability. In recent decades, mixed land use is introduced as a key element in Transit Oriented Development, Traditional Neighborhood Development, smart growth and new urbanism. Mixed land use means every combination of

land uses that can be vertically, horizontally or time combined with each other. The concept of mixed land use from the viewpoint of spatial planners is an important tool to achieve sustainable development. In order to evaluate the presented model from the viewpoint of mixed land use, a proper spatial criteria and an evaluation method is required. In this study, many methods of evaluation of versatile criteria and a positional criterion for evaluating mixed land use are investigated. Then, a Geographic Information system is used as a powerful means of analyzing and administrating the spatial data. The method in this paper is applied for the horizontal dimension in the 7th regional municipality of Tehran city.

Author (s)

Gh. Javadi (✉)
MA. Student in Geographical Information Systems (GIS), faculty
K.N.Toosi University of Technology, Tehran, Iran.
e-mail: Ghasem_Javadi@yahoo.com

M. Taleai
Assistance professor in faculty of geodesy & geomatics, K.N.Toosi
University of Technology, Tehran, Iran.

M. Karimi
Assistance professor in faculty of geodesy & geomatics, K.N.Toosi
University of Technology, Tehran, Iran.

2- Theoretical bases

Evaluation criteria for mixed land use can be categorized based on different concepts. With respect to effective factors in mixed land use (four dimensions: Horizontal, vertical, shared premises and time

URS Journal

dimensions, land uses, Geographic scale and spatial criteria), this procedure is a very complex issue.

Compositional pattern of land use mixture is a method to determine spatial assimilation of land development and is very important in the study of mixed land use. To evaluate mixed land use model, this criterion is divided into Evenness and Diversity and clustering. In this study, the aim of criteria evaluation is to determine the diversity of urban mixed land use via GIS.

Mixed land use model evaluation based on Diversity

Evaluation of Diversity in mixed land use compares its distribution in the presented region. In this study and to evaluate this analysis, Balance and Gini criteria are used to evaluate mixed land use and HH and Entropy criteria are used to evaluate more than two mixed land uses. Also, Dissimilarity and Atkinson criteria are used for evaluating two and more mixed land uses.

2-1- Balance Index

This index can evaluate two mixed land uses. When two land uses are distributed evenly, this criterion is unity and when there is only one land use in the region of analysis, this index would be zero. This Index's merit is its computational ease.

2-2- Herfindahl-Hirschman index (HHI)

This index is defined as the squared area summation for every land use in the region of analysis. When there is only one land use this index is 10000. In this index the more close to 10000 the less the level of diversity in mixed land uses. This index is very simple and its limitation is its relation to Modifiable Areal Unit Problem.

2-3- Dissimilarity Index

This index shows the level of sameness of the distribution model of land use in a smaller analysis unit and a larger analysis unit. The value of this index is between zero and unity. Unity shows the perfect sameness and the zero shows Dissimilarity. This index can analyze diversity in two or more mixed land uses. Although this index is simple and easy to implement, it has many limitations.

2-4- Gini index

This index can only investigate two land uses in their diversity and can have a value between zero and unity. Zero shows a perfect sameness and unity shows inhomogeneous distribution.

2-5- Entropy index

Entropy index is a method to evaluate variations and diversity. Zero shows that all the uses in the region are the same as each other. Unity shows a perfect inhomogeneity. This criterion can investigate more than two land uses for the analysis of mixed land uses diversity in different level. Although other index like Dissimilarity index can also evaluate more than two land uses, simplicity of this criterion made it the perfect option for the analysis.

2-6- Atkinson index

Atkinson index is one of those rare methods that not only evaluates inhomogeneous distributions but also assigns a weighting value to subunits. The range of values for this index is between zero and unity. Unity shows a great homogeneity of land uses distribution. This index can investigate two or more mixed land use diversities. This index creates a great practical opportunity for assigning different weighting values to different land uses distributions and makes the

fundamental modifications.

3- Discussion

To evaluate the results of distribution pattern (diversity) of urban mixed land use via GIS in the mentioned region, according to the conceptual model of Mixed Land Use, this analysis based on the diversity index is done for the 7th region of Tehran city.

Implementation of the presented methods consists of two steps:

- To evaluate MLU Diversity between two land use (residential and non-residential land uses) in district and neighborhood level, Dissimilarity index, Gini index and Atkinson index are implemented. Results obtained from these presented indexes demonstrates these 5th district and Dabestan, Khaghani, Amjadih and Kaj's neighborhoods from viewpoint MLU Diversity are in better condition. Calculated criteria according to obtained results from evaluation of MLU Diversity show a great correlation for the criteria. Criteria $A_{0.5}$ is more like the D_N and G_N criteria. This is because an $A_{0.5}$ criterion is not modified for the area-related dimension. In this study, as we mentioned before, to calculate D_N and G_N squares with side length of 100 meters are used and the obtained results as expected show a great correlation between these two criteria. It is seen that these criteria not only are sensitive to the diversity of subunit interior but also their results are dependent to the positions of the cells.

- To evaluate diversity of urban MLU in more than two land uses (residential and nonresidential land uses) in district and neighborhood level, D_m and Entropy and Atkinson are implemented. With respect to this, region or district that has only one application has the number zero and the regions with more applications have a number more than zero

and less than unity. Results obtained from the proposed criteria demonstrate in the 4th and 5th districts and Amjadih, Dabestan, khaghani and Kaj's neighborhoods are in better condition with respect to diversity of MLU. And about correlation between indicator show that values for HH and Atkinson have great correlation for these criteria.

4- Conclusion

Urban land use planning deals with how to assign different land use to Land. Over the past few decades mixed land uses development become a model for urban planning, and due to social, economic and environment benefits has been well received in the advanced countries. In this study, Identify the strengths and weaknesses of indicators of diversity in MLU, the proposed indicators for the horizontal dimension urban neighborhoods and districts in the 7th regional municipality of Tehran city will implement. Practical analysis of indicators for the analysis presented above in the study area, indicating the ability of the proposed indicators to evaluate the MLU diversity in the study area.

Based on the results of this study, using criteria set Atkinson ($A_{0.1}$, $A_{0.5}$, $A_{0.9}$) to evaluate the diversity for mixing of the two types land use (for example in research, non-residential and residential land use) is recommended. The reasons of propose for these indicators include:

- Weaknesses of other methods (indices of dissimilarity and Gini) to reflect the correct amount of diversity in the Urban mixed land use. For example, the Gini and dissimilarity indices are not a very discriminating indicator and two very different distributions can have exactly the similar indicators. In order to implement the dissimilarity index, in order to implement this index, both types of the

land uses must be present in the study area. In our example, the index would not be computed for the neighborhoods with either only residential or only non-residential land uses.

- Indices of Atkinson provide a practical opportunity for assigning weights to various land use distributions and making normative adjustments. In this index, α , inequality aversion parameter, get amounts to between zero and infinity. Depending on the type and purpose of evaluation we can assign the proper value to the α . If a value greater than zero but less than 0.5, areal units of the proportion of nonresidential land uses is smaller than the study area's average contribute more to the index and for values greater than 0.5 to 1, the opposite is true. When is equal to 0.5, such areas contributing equally.

After analyzing the results of each index, the HHI and Entropy indicator, to assess the diversity in MLU for more than two (e.g. in this research, land uses of housing, urban civil service, cultural and leisure, commercial, administrative and law enforcement and other land uses) is recommended; reasons of propose for this indicator:

- The ability to model more than two land uses in the calculation
- Simplicity in computation and less computational time
- And these indicators are more understandable public.

5- Suggestions

It seems that integrating urban planning models with Geographic Information Systems should lead to the development of new models for integrating the various aspects of the spatial planning. The urban planning based on GIS, in addition to

supporting the development of new analytical models, leads to the release of restrictions in the conventional urban models and enables us to think beyond the issues raised in the past decades. In this regard, urban planners in dealing with new issues in urban use from GIS -based development tools, apply appropriate flexibility in analysis and integrate them with other spatial planning models. Although the proposed indicators in this study have a proper assessment of the diversity of urban MLU, success came is not a complete solution of this problem and the other research in this direction should be considered.

The suggestions for future:

- Formulations of mixed uses development are insufficient in terms of diversity criteria. It also comprises other features such as the urban experience, the nature of uses, definitions of public and private, land use Incompatibility, conflict and security.

- It is suggested that to evaluate urban Mixed land use, in addition to diversity index, other indicators such as the amount of accessibility of housing to other fundamental land use, such as commercial, office, leisure and etc., amount of Clustering Land uses, amount of intensity in the area of analysis, and also incompatibility between land uses be considered in the future research.

- In order to improve diversity and positive impact of mixed land uses in the area of study, aggregation of the proposed models in this research and GIS, site selection and allocation of land uses for area of analysis towards the goals and advantages of mixed land uses are proposed.

Key Words: Mixed land uses, diversity of land uses, urban planning, GIS, land use evaluation

References

- Atkinson, A. B., (1970), On the Measurement of Income Inequality, *Journal of Economic Theory*, Vol. 2, p.p. 244-263.
- Brown, M., (1994), Using Gini-style indices to evaluate the spatial patterns of health practitioners; theoretical considerations and an application based on the Alberta data, *Social Science and Medicine*, Vol. 38, No. 9, p.p. 1243-1256.
- Cervero R., Kochelman K. M., (1997), Travel Demand and the three Ds: Density, Diversity and Design, *Transportation Research D*, Vol. 2, p.p. 199-219.
- Duany, A., Plater-Zyberk, E., (1992), "The second coming of the American small town", *Plan Canada*, p.p 6-13.
- Ewing, Reid, Cervero, Robert, (2002), Travel and the Built Environment, *Transportation Research Record*, No. 1780, p.p. 87-114.
- Gini, C, (1912), "Variabilità e mutabilità" reprinted in *Memorie di metodologica statistica* (Ed. Pizetti E, Salvemini, T). Rome: Libreria Eredi Virgilio Veschi 1955.
- Habibi, H., Masaeli, S. (2000), 1st Ed, National Land and Housing Organization Publications, Tehran, Iran.
- Habibi, Q., Pourahmad, A. (2006), Physical development of the Sanandaj city using GIS, University of Kordestan Publications, Tehran, Iran.
- Hoppenbrouwer, Eric, E. Louw, (2005), Mixed-use Development: Theory and Practice in Amsterdam's Eastern Docklands, *European Planning Studies*, Vol. 13, No. 7, p.p. 967-983.
- Jacobs, J. (2008) *The Death and Life of Great American Cities*, Parsi, H., Aflatoni, A., 1st Ed, Institute of Publishing and Printing of University of Tehran, Tehran, Iran.
- Kaiser, E. J., D. R. Godschalk, and F. S. Chapin, Jr., (1995), *Urban land use planning*. 4th edition, University of Illinois Press, Urbana, Illinois, USA.
- Massey, D. S., Denton, N. A., (1988), The dimension of residential segregation, *Social Forces*, Vol. 67, p.p. 281-315.
- Mohamadhoseinian, Sh. (2009), Development of GIS-based decision model to assess neighborhood-scale urban Land, M.Sc. thesis, Mesgari, M., Alomohammadi, A., faculty of Geodesy & Geomatics, K.N.Toosi University of Technology, Tehran, Iran.
- Parhizkar, A., Shokohi, H. (1999), Appropriate pattern of Allocation of urban centers utilities, *Journal of Modarres*, No.4, Tehran, Iran.
- Planning Center of Tehran, (2004), *Contract of working with municipalities and regional development issues on Tehran 7th Municipality*, Tehran, Iran.
- Pormohammadi, M.R. (2008), *Urban Landuse Planning*, SAMT Publising, Fourth Ed, Tehran, Iran.
- Roberts, M. & Lloyd-Jones, T., (1997), Mixed uses and urban design , p.p. 149-178 ,London: E & FN SPON.
- Rowley, A., (1996), Mixed-use development: Ambiguous concept, simplistic analysis and wishful thinking, *Planning Practice and Research*, Vol.11, No. 1, p.p. 85-97.
- Sakoda, J M, (1981), A generalized index of dissimilarity, *Demography*, Vol. 18, No. 2, p.p. 245-250.
- Saeednia, A. (2004), *Green Book of Municipalities: Urban planning*, Vol.1, Iran Municipalities Organisation, Fourth Ed, Tehran, Iran.
- Shiye, E. (1996), *Introduction to fundamentals of urban planning*, Vol.1, , University of I.U.S.T Publications,, 1St Ed, Tehran, Iran.
- Song, Y., Gerrit-Jan Knaap (2004). "Measuring the effects of mixed land

- uses on housing values", *Regional Science and Urban Economics*, Vol. 34, No. 6, p.p. 663-680.
- Taleia, M. (2007), Introduction to fundamentals of GIS-based planning support system for assessing the consequences of the Urban Land Detail, PhD thesis, Mesgari, M, faculty of Geodesy & Geomatics, K.N.Toosi University of Technology, Tehran, Iran.
- Turner, M G, Gardner, R H, and O'Neill, R. V., (2001), *Landscape Ecology in Theory and Practice: Pattern and Process*, Springer Verlag, New York.
- Urban Land Institute, (1987), *Mixed-use Development Handbook*, Urban Land Institute, Washington, DC.
- Vreeker, Ron, Henri L.F. De Groot and Erik T. Verhoef, (2004), *Urban Multifunctional Land Use: Theoretical and Empirical Insights on Economies of Scale, Scope and Diversity*, *Built Environment*, Vol.30, No. 4, p.p. 289-307.

Archive of SID