An Analysis of Rural Terminal Locations in Cities using the Weighted Linear Combination (WLC) Technique and ELECTRE Model (Case Study: Meshkinshahr)

Hadi Hakimi
Assistance Professor in Geography and Urban planning, University of Tabriz, Tabriz, Iran

Zahra Rezazadeh
MA Student in Remote Sensing and GIS, University of Tabriz, Tabriz, Iran

Roghayeh Askarnezhad [1]
MA Student in Remote Sensing and GIS, University of Tabriz, Tabriz, Iran

Received: 17 September 2018 ***Accepted: 15 December 2019***

Extended Abstract

1. Introduction

One of the important aspects of urban planning is the proper positioning of urban service elements. Within their extensive spectrum involving facilities and equipment, these services include elements that should be positioned in suitable locations according to a set of policies and criteria; terminals are one of those elements. As communication junctures between urban and suburban roads, the presence of terminals prevents the entrance of buses to cities; therefore, they play a constructive role in improving traffic, reducing urban environmental pollutions, and managing trips. Given the absence of terminals to provide services to the rural areas surrounding Meshkinshahr City, taxies and vehicles occupy the streets which results in traffic congestion and its related issues. Accordingly, this city was selected in this study which is aimed at identifying the most suitable location for a terminal.

2. Review of Literature

Some terms are needed to be clarified in this study.

Location: In his book titled *urban land use planning* Pourmohammadi (2003) defines location as an activity in which the capabilities of a region is assessed and analyzed in terms of suitable and sufficient land for a particular use.

Urban Transportation System: Urban transportation systems include facilities and services that enable travelling to the entire region and provides opportunities including i) movement of residents and commodities, and ii) access to different urban lands with various uses.

Terminals: Terminals are junctures in which travel and shipment begin or end.

Studies conducted on the area of rural terminal location are considerably limited. Foreign sources in this field has mostly been focused on identifying locations for multiple stations using network analysis as well as achieving the best possible model to minimize costs. A number of domestic inquiries involve terminal location using methods such as AHP, P-Median, etc. through multiple criteria.

3. Method

The purpose of the present study is applied in which the causal method was employed. There are a number of different indices for terminal location; the indices used in this study was examined in four aspects including physical, environmental, economic, and social. Indices used in the physical aspect include adjacency to the main roads, access to the main urban routes,

1. Corresponding Author- Email: r.askarnezhad69@gmail.com

adaptability, access to facilities and equipment. In the environmental aspect, indices included digital elevation model, and gradient, and distance from rivers. The economic aspect involved the land cost and finally, the social aspect included population density and households.

In order to express the relative significance of indices, first their relative weight should be determined. To this end, the analytic hierarchy process (AHP) method was employed. Through indicating the priority of layers over each other using the Expert Choice software, the final weight of each layer was obtained with an instability coefficient of 0.02. Then, the layers should be standardized using fuzzy logic. Unlike Boolean logic, the certainty problem does not exist in fuzzy logic and each layer is graded at a scale between zero to one. At these scales, higher values mean higher utility. In addition to the issue of choosing a scale to draw fuzzy maps, the type of the fuzzy function should also be examined; in this study, functions including sigmoidal, linear and user-defined were used. Moreover, one of the points that should be taken into account while standardizing fuzzy maps is indication of the threshold limit which is also called control points.

The ELECTRE method is one of the multi-criterion decision analysis methods used from the middle of 1960s in Europe. As a "non-grade" method, options in this method are not graded. The ELECTRE method was employed in this study in order to grade suitable zones. In this method, all options are assessed using non-graded comparisons and ineffective options are removed.

4. Results and Discussion

Following the preparation of the intended layers in Arc Map and the application of weights obtained from weighing process in the expert choice software using the AHP method, a model was provided in which criteria including closeness to main roads with a weight of 0.234 and distance from rivers with a weight of 0.029 involve the highest and lowest final weights, respectively. Other criteria involved weights between these two values. Next, layers were standardized in the Idrisi software. Then, layers were multiplied by each other using the GIS Analysis command in Idrisi software and the obtained result included a zoning in which the suitable locations for terminals were expressed. Finally, zones with perfect potentials were graded using the ELECTRE model; the grading results showed that option 1 which is located in the northern part of the city and involves the closest access to the main road is the first suitable option for a terminal. Another reason this location was selected is that passengers who enter the city can gain access to the main urban routes as fast as possible. Moreover, land uses present at this zone are more adaptable to the terminal and there are more arid lands where terminals can be constructed. In terms of land prices, this option is more cost-effective compared to others. Other priorities were obtained as options 2 and 3 (South East of the city).

5. Conclusion

In this study, different social, economic and natural aspects were examined and scientific models and principles were employed in order to identify suitable locations for terminals. First, the accessible informational layers and criteria were studied and location analyses were conducted so as to obtain an output map that shows suitable and unsuitable zones for terminal construction. Then, zones with perfect potentials were graded using the ELECTRE model.

The majority of studies conducted in the area of terminal location have mostly focus on physical, environmental, economic, and social factors. It was also attempted in this study to take all these factors into account. However, the merit of the present study lies within the use of the WLC model and the ELECTRE method for zoning and grading suitable zones, respectively.

Recommended Strategies:

1. For the purpose of cost-effectiveness, the construction of the terminal should begin before the price of the zone is increased.

2. The establishment of incompatible land uses should be prevented before the construction of terminal.
3. Since the criterion regarding the multitude of the surrounding rural areas was overlooked in this study due to certain limitations, this index is recommended to be examined in future research.

Keywords: ELECTRE, AHP, Terminals, Meshkinshahr City, Location, Fuzzy Logic

References (In Persian)

1. Afsahi, O., Ebrahimi, A., & Asgaripour, M. (2012). ارائه مدل مکان‌یابی پایانه‌های اتوبوس بین‌شـــهری با استفاده از روش P-Median (مطالعه موردی شـهر تهران). [Presenting a model of intercity bus terminals locating using P-median (Case study: Tehran city)]. Paper presented at The 12th International Conference on Traffic and Transportation Engineering. Traffic Organization, Tehran, Iran.
2. Amininejad, S. R., & Eftekhari, Gh. (2010). *مقدمه‌ای بر برنامه‌ریزی حمل‌ونقل شـهری (رشته جغرافیا)* [An introduction to planning of urban transport (Geography)]. Tehran, Iran: Payam Noor University Press.
3. Asgharpour, M. J. (2008). *تصـــمیم‌گیری چنـد معیاره*. [Multiple-criteria decision]. Tehran, Iran: Tehran University Press.
4. Banian Engineers Council. (2001). *طـرح جـامـع شـــهر مشـــکین‌شـــهر* [Comprehensive plan of Meshkinshahr] (Vol. 2). Retrieved from (limited access website) http://archive.mrud.ir
5. Farzi, E. (2003). مکانیابی پایانه شهرستان شهریار [Locating terminal of Shahriar]. Paper presented at *10th Conference on Civil Engineering*. Amirkabir University, Tehran, Iran.
6. Mousavi, M., Ebrazi, R., & Tashakori Hashemi, M. (2013). بررسی تعریف و ویژگی های اساسی پایانه ها و ارائه روش مکانیابی پایانه مبتنی بر تعیین میزان انحراف از جامعه نرمال [Exploring the basic definition and features of terminals and presenting a terminal locating method based on deviation from normal society]. Paper presented at *13th International Conference on transportation engineering.* Transportation Organization, Tehran, Iran.
7. Nochian, A., & Rafiyan, M. (2010). ارائـه الگوی منـاســـب مکـان‌یابی پایانه‌های مســـافربری برون‌شـــهری [Presenting a sutable model for intercity terminals locating]. Paper presented at the *2nd Conference on Planning and Urban Management*. Ferdowsi University of Mashhad, Mashhad, Iran.
8. Pourebrahim, Kh. (2010). *مکان‌یابی ترمینال بین‌شهری (مطالعه موردی: شهر تسوج)* [intercity bus terminals locating (Case study: Tasuj city)] (Unpublished MA thesis). Payam Noor University, Tehran, Iran.
9. Pourmohammadi, M. R. (2003). *برنامه‌ریزی کاربری اراضی شهری* [Urban land use planning]. Tehran, Iran: SAMT.
10. Saeedi, A. (2003). روابط شـهر و روسـتا و پیوندهای روستایی-شهری [City and village relationships and ties]. *Geography, 1*(1), 71-91.
11. Soleymanikermani, M. R., & Mazraeh, S. (2014). مکانیابی پایانه های مسـافربری برون شهری با استفاده از مدل بهینه سـازی چند معیاره در شهر تهران [Tehran suburban passenger terminals locating using multi-criterion optimization model]. *Transportation Research, 11*(1), 55-72.
12. Statistical Center of Iran. (2016). *نتایج سـرشـماری عمومی نفوس و مسـکن* [Results of the general census of population and housing]. Tehran, Iran: Statistical Center of Iran.

References (in English)

1. Al-Shalabi, M. A., Mansor, S. B., Ahmed, N. B., & Shiriff, R. (2006, October). GIS based multicriteria approaches to housing site suitability assessment. Paper presented at *XXIII FIG Congress, Shaping the Change,* Munich, Germany.
2. Djenić, A., Radojičić, N., Marić, M., & Mladenović, M. (2016). Parallel VNS for bus terminal location problem. *Applied Soft Computing*, *42*, 448-458.
3. Dufaux, F. (2008). *Birth announcement.justice spatial/spatial justice*. Retrieved from https://www.jssj.org/wp-content/uploads/2012/12/JSSJ1-0en2.pdf
4. Görener, A., Toker, K., & Ulucay, K. (2012). Application of combined SWOT and AHP: a case study for a manufacturing firm. *Procedia-social and Behavioral Sciences*, *58*, 1525-1534.
5. Hu, Y. C. (2009). Bankruptcy prediction using ELECTRE-based single-layer perceptron. *Neurocomputing*, *72*(13-15), 3150-3157.
6. Lin, C. C., & Lin, S. W. (2016). Two-stage approach to the intermodal terminal location problem. *Computers and Operations Research*, *67*, 113-119.
7. Lin, C. C., Chiang, Y. I., & Lin, S. W. (2014). Efficient model and heuristic for the intermodal terminal location problem. *Computers & Operations Research*, *51*, 41-51.
8. Lynch, K. (2005). *Rural-Urban Interaction in the developing world*. London, England: Routledge.
9. Malczewski, J. (1999). *GIS and multi criteria Decision Analysis.* New York, NY: John Wiley and sons Inc.
10. Schilling, D. A. (1980). Dynamic location modeling for public-sector facilities: A multicriteria approach. *Decision Sciences*, *11*(4), 714-724.
11. Semih, T., & Seyhan, S. (2011). A multi-criteria factor evaluation model for gas station site selection. *Evaluation*, *2*(1), 12-21.
12. Sörensen, K., & Vanovermeire, C. (2013). Bi-objective optimization of the intermodal terminal location problem as a policy-support tool. *Computers in Industry*, *64*(2), 128-135.
13. Sörensen, K., Vanovermeire, C., & Busschaert, S. (2012). Efficient metaheuristics to solve the intermodal terminal location problem. *Computers and Operations Research*, *39*(9), 2079-2090.
14. Valizadeh Kamran, Kh., & Shahabi, H. (2009). Necessities of GIS usage in urban water management at the time of natural accidents (Case study: Saqqez city). Paper presented at *International Conference on Geographic Information Systems*. Paris, France.
15. Wang, X., & Triantaphyllou, E. (2008). Ranking irregularities when evaluating alternatives by using some ELECTRE methods. *Omega*, *36*(1), 45-63.
16. Zavadskas, E., Viteikienė, M., & Šaparauskas, J. (2007). Sustainable development assessment of cities and their residential districts. *Ekologija*, *53*, 49-54.

How to cite this article:

Hakimi, H., Rezazadeh, Z., & Askarnezhad, R. (2019). An analysis of rural terminal locations in cities using the Weighted Linear Combination (WLC) technique and ELECTRE model (Case study: Meshkinshahr). *Journal of Geography and Urban Space Development, 6*(1), 81-101.

URL http://jgusd.um.ac.ir/index.php/gud/article/view/67423

ISSN: 2538-3531