

**A Spatial Analysis of Petrol Stations and Identification of the Optimized
Construction Locations for New Stations Using MCDM and GIS
(Case Study: Region 6 of Tehran Municipality)**

Yaghoub Moradi

Assistant Professor of Geography and Urban Planning, University of Payam-e Noor Tehran, Iran

Narges Nazari

MA in Geography and Planning, University of Payam-e Noor Tehran Center, Iran

Mohammad Reza Boshagh¹

Ph.D in Geography and Rural Planning, University of Isfahan, Isfahan, Iran.

Hamzeh Rahimi

Ph.D Student of Geography and Rural Planning, University of Isfahan, Isfahan, Iran.

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Extended Abstract

1. Introduction

High traffic volume is one of the most common problems of urban transportation in metropolises. The increase in the number of vehicles in case of not having necessary predictions also enhances the demand for fueling in places where mostly are unable to respond to such needs. Site selection of public facilities is an instance of policies of local governments with understanding profits due to savings in the use of resources, increasing efficiency and synergy of services, and enhancing the sense of collectivism. Such profits are highly vital particularly for those governments which are experiencing rapid population growth. Appropriate development and balanced uniform distribution of fueling stations will result in valuable achievements. The reduction in the duration and the length of fueling travels, fueling near the residential place and increasing citizens' welfare, appropriately accessing fueling stations, the absence of gridlocks and lines in stations, increasing safety and reducing economic costs of supplying lands are among these

achievements. Diverse factors such as population, economic and geographical aspects, and governmental policies, etc. should be considered in selecting optimal places for fueling stations. One of these systems is GIS. Accordingly, regarding the significance of the issue of site selection in cities such as site selection of fueling stations, the aim of the present study is optimal site selection for gas stations in Tehran's 6th Municipality District.

2. Theoretical Framework

The multi-criteria decision making method refers to concepts, approaches, models, and methods contributing to evaluation base on weights, values, or the degree of superiority from the decision maker's viewpoint, and finally results in better decision making. Since the 1960's, the integration of the multi-criteria decision making method with GIS was considered by urban planners for solving problems of spatial planning and consequently, the multi-criteria approach and GIS became bases for solving problems of planning which were involved in multiple conflicting aims such as issues of allocating land uses. This approach is so simple and

¹ Corresponding Author: Email : m.r.boshagh@gmail.com

flexible that a lot of criteria and indicators can be applied in it. However, decision makers may face problems in allocating weights to each of these criteria based on paired comparison. The integration of the multi-criteria decision making in the form of GIS for optimally zoning urban services can have many more applications. AHP is among multi-criteria decision making methods mixing qualitative and quantitative analyses, and was presented by T. L. Satti, a US expert at operational research in the 1970's.

3. Methodology

The present study is applied-developmental. The research method was descriptive-analytical. In the descriptive part of the study, library research and documentary analysis were employed. In the analytical part of the study, by investigating factors affecting site selection of gas stations, and using the land map of Tehran's 6th District, numerical layers were created and analyzed by GIS. Then, applying the integrated method of GIS and MCDM and using AHP, as well as creating considered changes in information layers, the desired results of optimal site selection of gas stations and evaluation of current stations were achieved. The multi-criteria decision-making method is one of the concepts, approaches, models, and methods contributing to decision makers' evaluations based on weights, values, and the degree of superiority. Finally, it results in better decision making. The main objective of multi-criteria decision making methods is to investigate a number of alternatives regarding the diverse criteria and conflicting aims.

4. Results

The results of calculated weights indicated that the access to the communication network with the highest weight as 0.482 and also the population density with the weight as 0.268 have very high significance and roles in site selection of fueling stations, while other indicators investigated in the

present study have less significance. The results of the study also indicated that from among compatible land uses, fire stations with the weight as 0.421, public parking lots with the weight as 0.343, and urban terminals with the weight as 0.236 have the highest significance, respectively. Moreover, from among incompatible land uses, residential land uses with the weight as 0.331 and green spaces with the weight as 0.262 have the highest significance. The results indicated that five stations were in optimal locations, three stations were in relatively appropriate locations, and only one station was located at an inappropriate place. Therefore, except for the northeast strip and the west of the District which have inappropriate conditions for constructing new stations, other parts especially the center and south of the District have provided appropriate conditions for constructing new stations.

5. Discussion

The process of selecting optimal sites starts with identifying effective factors, and then these factors are placed in a hierarchy using the decreasing AHP model from the general aim to different criteria and sub-criteria at sequential levels. There are a lot of criteria for site selection of gas stations regarding global standards, but applying all of them in zoning is impossible due to different reasons. In the present study, four criteria were used for selecting optimal sites for gas stations of Tehran 6th District. These criteria are the degree of population density, access to the traffic network, natural hazards, and compatible and incompatible land uses.

6. Conclusion

The results indicated that regarding the maps of land use, the selected criteria and investigations in Tehran's 6th District, stations 2, 108, 115, 145, and 153 are located at optimal places and stations 15, 22, and 110 at relatively optimal places. In addition, station 24 is located at an inappropriate location. Therefore, it is better that in case of

setting up new locations, potential places with high capacity be identified in order that new stations play more roles in eliminating urban problems. In contemporary urban structures, easiness and access to aims are prioritized and planning should be

conducted regarding the power and identification of capabilities of zoned regions and districts.

Keywords: Locating, Petrol stations, MCDM, AHP, GIS, Region 6 of Tehran.

References (in Persian)

1. Amami, H. (2007). *Investigation and site selection of formal documents center by using geographical information system (GIS) and analytical hierarchy process modeling (AHP)* (Unpublished master's thesis). Islamic Azad University, Semnan, Iran.
2. Feghehi Frahmand, N., & Haji Karimi, B. (2010). Site selection of fire stations using multi-criteria decision making TOPSIS and SAW and site selection of the optimal using Breda method (Alborz Ghazvin industrial city). *Journal of Quantitative Studies in Management*, 1(3), 53-67.
3. Hadiyani, Z., & Kazemi Zad, Sh. (2010). Site selection of fire stations using network analysis method and model AHP in GIS (Case study: Qom city). *Journal of Geography and Development*, 8(17), 99-112.
4. Hashemi, C.A., Kafi, M., Hashemi, C.M., & Khan Sefid, M. (2009). The analysis of trend of changes in urban green space (Case study: area 2 of Tehran). *Journal of Environmental Sciences*, 6(3), 73-86.
5. Meshkini, A., Hasel Talab, M., Yapeng Ghravi, B. M., & Alavi, C.A. (2011). Determining the optimal location space-local parking places approach by Geographical Information System(GIS) and multi-criteria decision making: Region 6 Tehran Municipality. *Quarterly Journal of Environmental Based Territorial Planning*, 4(13), 1-20.
6. Mirkatouli, J., & Kanani, M.R. (2011). Assessment of ecological capability of urban development by using Multi-criteria Decision Making Model (MCDM) and GIS (Case study: Sari city, Mazandaran province). *Quarterly Journal of Human Geography Research*, 43(77), 75-88.
7. Pourmohammadi, M. (2008). *Planning urban land use*. Tehran: Samt Publication.
8. Razaviyan, M.T. (2002). *Planning urban land use*. Tehran: Monshi Publication.
9. Roustaei, Sh., Ghanbari, H., KazemiRad, Sh. & Nourian, R. (2011). Display of optimal pattern site selection neighborhood using Geographical Information System (GIS) and Analytical Hierarchy Process modeling (AHP) (Case study: Region 3 and 4 of Tabriz Municipality). *Journal of Geography and Development*, 9(23), 163-184.
10. Talebi, R. (2010). Optimum setting of parking places in Tehran City (Case study: Area 7 of Tehran). *International Journal of Urban and Rural Management*, 8(26), 119-131.
11. Valikhani, N., Charkhabi, A.H., Khikhah Zarkesh, M., & Soltani, M.G. (2011). Application of Geographical Information System (GIS) and Multi-criteria Decision Making (MCDM) in zoning degree of appropriateness development physical of urban land (Case study: Northern part of Karaj city). *Journal of Remote Sensing and GIS in natural resources*, 2(2), 1-13.
12. Zebardast, A. (2001). Application of analytical hierarchy process in urban and regional planning. *Journal of Fine Arts*, 10, 13-21.
13. Ziyari, Y. A., & Hossein Mardi, M. (2009). The survey and analysis of civic land operations and voting weight standard and discovering position of the CNG gas pumps by using the AHP model. *Quarterly Journal of Human Geography*, 2(1), 39-52.

References (in English)

1. Aslani, M., & Alesheikh, A. (2011). Site selection of small gas stations using GIS. *Journal of Scientific Research and Essays*, 6(5), 3161-3171.
2. Chang, N., & Breeden, P. (2008). Combining GIS with Fuzzy Multicriterial Decision-Making for landfill siting in an urban region. *Journal of Environmental Management*, 87(1), 139-153.
3. Jinajun, Z. (2005). *The Analytic Hierarchy process (AHP) research and its application in some problems*. Northeast University, Shenyang, China.
4. Karakitsios, S. P., Delis, V. K., Kassomenos, P. A., & Pilidis, G. A. (2007). Contribution to ambient benzene concentrations in the vicinity of petrol stations: Estimation of the associated health risk. *Journal of Atmospheric Environment*, 41(9), 1889–1902.
5. Kumar Dey, P. (2003). Analytic hierarchy process analyzes risk of operating cross-country petroleum pipelines in India. *Journal of Natural Hazards Review*, 4(4), 213–221.
6. Phua, M. H., & Minowa, M. (2005). A GIS-based multi-criteria decision making approach to forest conservation planning at a landscape scale: A case study in the Kinabalu Area, Sabah, Malaysia. *Journal of Landscape and Urban Planning*, 71, 207–222.
7. Rida, A., Diabat. A., & Shatnawi, G. (2010). Combining GIS with multicriteria decision making for sitting water harvesting ponds in Northern Jordan. *Journal of Arid Environments*, 74, 1471-1477.
8. Terrés, I. M., Miñarro, M.D., Ferradas, E.G., Caracena, A.B., & Rico, J. B. (2010). Assessing the impact of petrol stations on their immediate surroundings. *Journal of Environmental Management*, 91(12), 2754-2762.
9. Triantaphyllou, E., & Mann, S. (1995). Using the analytic hierarchy process for decision making in engineering applications: Some challenges. *International Journal of Industrial Engineering: Applications and Practice*, 2(1), 35-44.
10. Viana, M. (2004). Intelligent transportation systems and parking management: Implementation potential in a Brazilian city. *Journal of Cities*, 21(2), 137- 148.
11. Zhen, Y. (2010). Research on fuzzy comprehensive evaluation method based on AHP. South China University of Technology, Guangzhou.
12. Zolnik, E., Minde J. B., Das Gupta, D., & Turner, S. (2010). Supporting planning to co-locate public facilities: A case study from Loudoun County, Virginia. *Journal of Applied Geography*, 30(4), 687–696.

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