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An application of AHP for facility location in fruit and vegetable markets

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C H R O N I C L E

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A B S T R A C T

These days, one of primary concerns for residence of big cities is associated with the access on shopping centers. People prefer to live in places, which are close to their works, shopping centers and schools. Local governments also prefer to find the most appropriate places in an attempt to reduce unnecessary travels and traffic jams. In this paper, we present an empirical investigation to determine the most important factors influencing facility location for fruit and vegetable market in city of Tehran, Iran. The study has implemented two methods of analytical hierarchy process (AHP) and factor analysis for the investigation. The implementation of AHP has considered two main criteria including Geographic location of market and market, amenities and existing infrastructures. In terms of Geographic location of market, cost saving and public infrastructure are found to be the most important factors while in terms of market based factors, Space and availability of parking are the most important factors. We also use factor analysis and the results of our survey have indicated that Space and Ease of access were two most important factors, which must be considered for facility location.

1. Introduction

These days, one of primary concerns for residence of big cities is associated with the access on shopping centers. People prefer to live in a place, which is close to their works, shopping centers and schools. Local governments also prefer to find the most appropriate places in an attempt to reduce unnecessary travels and traffic jams. There are also various studies on locating facilities on public places. Teixeira and Antunes (2008), for instance, presented a discrete hierarchical location model for public facility planning. The primary objective of the model was associated with an accessibility maximization objective, etc. Batta et al. (2014) explained that the suitable use of dispersion, population, and equity criteria could lead to appropriate solutions with respect to the p-median objective for public facility locations. According to Chen et al. (2009) emergency signs are important in ensuring public safety in facilities during emergencies and provided a mathematical model for public facility location by considering safety issues. Yeh et al. (1996) provided an integrated GIS and location-allocation method to public facilities planning—an example of open space planning. Berliant

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et al. (2006) developed a mathematical model with a finite number of households and congestible local public goods where the level of provision, the number of facilities and their locations were all endogenously determined. They proved that an equal-treatment identical-provision second-best optimum was available, where all households were needed to reach the same utility level, the provision of local public good was needed to be the same at all facilities, and all facilities should serve the same number of consumers. Such an optimal public facility configuration could be either single site or dispersed, depending on commuting expense and household preference parameters.

2. The proposed study

We present an empirical investigation to locate the best possible places for development of fruit and vegetable market city of Tehran, Iran. The proposed study uses analytical hierarchy process (AHP) for facility location (Saaty, 1990, 1994, 2003). There are two main criteria of geographic location of market and Amenities and existing infrastructures for development of fruit and vegetable markets. Fig. 1 shows the criteria. The proposed criteria used in Fig. 1 are considered for six regions in city of Tehran, namely, regions 1, 6, 12, 13, 16 and 22. In order to find the appropriate weights for different criteria, we have asked some food consumers in this city to give their opinions in terms of Likert scale about different factors. For the first level, Geographic location of market receives a relative weight of 0.67 while market, amenities and existing infrastructures factor receives a relative weight of 0.33. The pairwise comparisons have been applied among all criteria and the relative weights were ranked using AHP method. In terms of Geographic location of market, cost saving and public infrastructure are the most important factors while in terms of market based factors, Space and availability of parking are the most important factors.

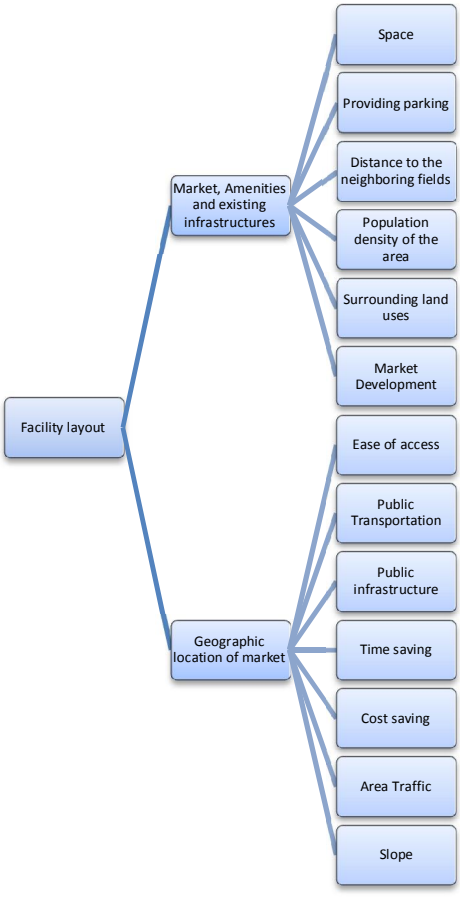

Fig. 1. The structure of the proposed method

We have also performed factor analysis to extract important factors out of 13 detected factors shown in Fig. 1 and Table 1 shows the summary of the results. In addition, Fig. 2 shows details of Scree plot, which shows the number of important factors is equal to two.

Table 1
The summary of factor analysis

Item	Preliminary eigenvalues			Before rotation			After rotation		
	Eigenvalue	%Variance	% Accumulated	Eigenvalue	%Variance	% Accumulated	Eigenvalue	%Variance	% Accumulated
1	10.839	83.534	83.534	10.859	83.534	83.534	6.25	48.076	48.076
2	1.106	8.511	92.045	1.106	8.511	92.045	5.716	43.968	92.045
3	0.294	2.261	94.305	-	-	-	-	-	-
4	0.21	1.614	95.92	-	-	-	-	-	-
5	0.154	1.182	97.102	-	-	-	-	-	-
6	0.101	0.775	97.877	-	-	-	-	-	-
7	0.073	0.565	98.441	-	-	-	-	-	-
8	0.055	0.426	98.867	-	-	-	-	-	-
9	0.052	0.399	99.266	-	-	-	-	-	-
10	0.043	0.332	99.598	-	-	-	-	-	-
11	0.025	0.191	99.789	-	-	-	-	-	-
12	0.016	0.125	99.914	-	-	-	-	-	-
13	0.011	0.086	100.00	-	-	-	-	-	-

According to the results of Table 1 and Fig. 2, there are two factors namely, Space and ease of access, describing approximately 92% of total variance explained.

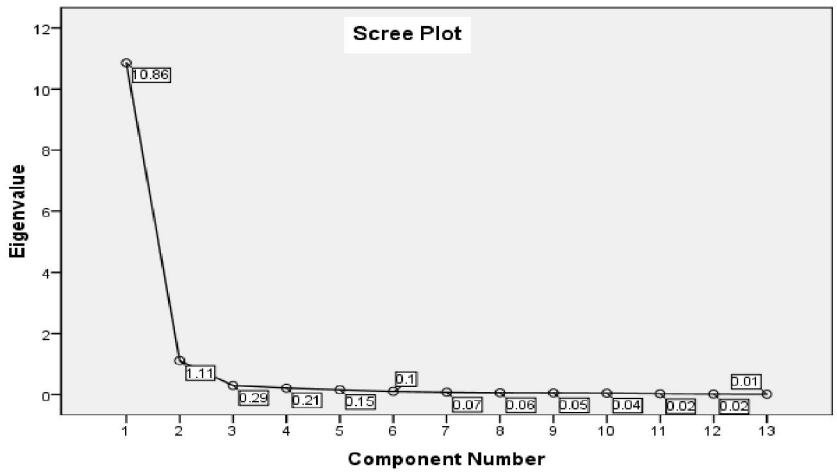

Fig. 2. The summary of Scree plot

3. Conclusion

One of the primary concerns in urban development is to locate appropriate pubic services such as hospitals, schools, shopping centers, etc. Detecting an appropriate public location helps society reach better services and eases people's lives (Fortney, 1996). In this paper, we have presented an empirical investigation to determine the most important factors influencing facility location for fruit and vegetable market in city of Tehran, Iran. There is no doubt that Tehran is one of the most populated cities in the world and it is important to locate such facilities to reduce traffic jam as much as possible. The study has implemented two methods of AHP and factor analysis for the investigation. The implementation of AHP has considered two main criteria including Geographic location of market and market, amenities and existing infrastructures. In terms of Geographic location of market, cost saving and public infrastructure are the most important factors while in terms of market based factors, Space and availability of parking are the most important factors. We have also used factor analysis and the results of our survey have indicated that Space and Ease of access were two most important factors, which must be considered for facility location.

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