MULTI-CRITERIA DECISION-MAKING APPROACH IN SINGLE FACILITY LOCATION SELECTION: A PROPOSAL FOR AN INTEGRATED MODEL [1]

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ABSTRACT

Selecting the right single-plant facility is crucial to maximizing the use of limited resources and minimizing effort waste. This study aims to provide decision-makers with a practical and effective approach that is as far as possible from individual subjective judgments when deciding on a single-plant facility. It differs from some other studies in the literature that leave the prioritization and weighting of criteria in the background in that it proposes a model in which decision-makers can determine their criteria for the location selection of a single facility and determine the extent to which these criteria are present in their alternatives. The step-wise weight assessment ratio analysis (SWARA) and the weighted aggregated sum product assessment (WASPAS) methods were used with an integrated approach. The results revealed that the approach used in this study was highly successful in the selection of a community pharmacy facility as a single-plant organization.

Keywords: *Pharmacy management****,*** *single-plant organization, facility location selection*
JEL Code: *M13, C61, I19*

Scope: *Business administration*
Type: *Research*

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[1] Compliance with the ethical rules of the relevant study has been declared.

TEKLİ TESİS YERİ SEÇİMİNDE ÇOK KRİTERLİ KARAR VERME YAKLAŞIMI: ENTEGRE BİR MODEL ÖNERİSİ

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ÖZ | Tek tesisli organizasyonlarda kuruluş yerinin doğru bir şekilde seçilmesi, sınırlı kaynakların kullanımını en üst düzeye çıkarmak ve çabaların boşa gitmemesini sağlamak açısından oldukça önemlidir. Bu çalışmanın amacı, karar vericilere tek tesisli kuruluş yeri seçiminde bireysel subjektif yargılardan mümkün olduğunca uzak, pratik ve etkili bir yaklaşım sunmaktır. Bu çalışma kriterlerin önceliklendirilmesi ve ağırlıklandırılması hususlarını geri planda bırakan literatürdeki diğer bazı çalışmalardan farklı olarak tek tesisli bir organizasyonun kuruluş yeri seçiminde karar vericilerin kendi kriterlerini belirleyip, mevcut alternatiflerde bu kriterlerin ne ölçüde bulunduğunu tespit edebileceği bir model önermektedir. Kademeli ağırlık değerlendirme oranı analizi (SWARA) ve birleşik ağırlıklandırılmış toplam çıktı değerlendirmesi (WASPAS) yöntemleri bütünleşik bir yaklaşımla kullanılmıştır. Elde edilen sonuçlar, bu araştırmada kullanılan yaklaşımın, bir tek tesisli organizasyon olarak serbest eczane yerinin seçilmesinde oldukça başarılı olduğunu ortaya koymuştur.

Anahtar Kelimeler: *Eczane işletmeciliği, tek tesisli organizasyon, tesis yeri seçimi*
JEL Kodları: *M13, C61, I19*

Alan: *İşletme*
Türü: *Araştırma*

1. INTRODUCTION

Researchers have been using a variety of approaches to try and find a solution to the facility location problem for over a century. Location theory was first put forward by Alfred Weber (1909) by addressing the problem of locating a single warehouse to minimize customers' travel distance, and Isard (1956) revisited Weber’s work in his investigation of industrial location, land use, and associated issues (Brandeau & Chiu, 1989). Following these early attempts, several studies to determine the optimal location for a facility contributed to the theory. These studies can be divided into three theoretical categories: the cost-minimizing theory, which focuses on identifying the least-cost location; the spatial interaction theory, which seeks to identify the facility that optimizes market access; and the profit maximization theory, which suggests that the optimal facility depends on both costs and the profits that can be made from each location (Mota & Brandao, 2013). There is also a purely empirical approach where the focus is on learning the reasons for location selection from the decision-maker (Carrier & Schriver, 1968). After a significant amount of development, location theory now plays a significant role in the field of quantitative approaches to management.

Competitive facility location is the type of location problem that an organization will experience when it undertakes a new business in a region where there are already competitors to create demand for itself by increasing the demands of customers or to attract existing demand to itself to obtain maximum benefit or market share (Brandeau & Chiu, 1989). Community pharmacies experience the problem of competitive facility location, especially during the establishment phase. The primary purpose of the community pharmacy, one of the smallest business structures, is to maximize its profitability to ensure sustainability while providing benefits to society. A mistake in the process of deciding on the location of the community pharmacy, i.e., not choosing the best location for any reason, will make it difficult or impossible to achieve this primary purpose.

The cost of a mistake in choosing the location of the establishment of large-scale enterprises, such as industrial production facilities, or multi-plant firms will be high in proportion to the structure of the enterprise. This is why several comprehensive, detailed, expert-requiring, and high-cost methods have been developed to be used in feasibility studies to select the location of the establishment of such organizations. These high methodological qualities make it impractical to use these methods in the selection of the location of community pharmacies, and methods that require such qualities are not suitable to be fully adapted to the study of the location of community pharmacies, which is the scope of this article. There are many criteria to consider when deciding on the optimal community pharmacy facility. The relatively most important of these criteria should be addressed in a hybrid and integrated way. This study aims to contribute to the field by addressing the current problem from a different perspective and by presenting a practical and efficient hybrid/integrated approach with a multi-criteria decision-making (MCDM) perspective suitable for implementation in community pharmacies as a single-plant organization. The main motivation of this study is to provide a solution to the problems faced by managers of single-site organizations such as pharmacies in terms of the challenges of facility location selection and the cost to society of potentially erroneous decisions. In the literature, there is a shortage of research on the facility selection of single-plant organization managers using the MCDM approach. This research provides a different perspective on the literature by offering a practical model for pharmacists to determine the important criteria in facility location selection, weight these criteria, and rank alternative facility locations according to these principles. In the first section of the study, the articles in the literature related to the subject of this research are presented; in the second section, the principles of creating the integrated model and the methodology of the research are explained; in the third section, the findings are reported; and in the last section, the results of the research are discussed.

2. LITERATURE REVIEW

As in many areas of business and management sciences, there is no universal method that is valid for every organization in terms of facility location selection. Some factors influence the selection of the facility location in quite different ways, depending on the characteristics of the organization (Mota & Brandão, 2013). One of these characteristics is the status of being a single-plant organization or a multi-plant organization. Mota and Brandão's (2013) research shows that the selection of a new single facility is more sensitive to labor costs, both localization and urbanization economies, and accessibility to main markets, while the selection of a new multiple facility is more sensitive to urbanization economies, land costs, and the size of the local market. Such characteristic differences are also reflected in the approaches to solving the location problem. In this context, mathematical and theoretical models of location problems for single and multiple facilities have been defined separately by Xu, Liu, Zhang and Liu (2018). Single facility location problems, including community pharmacy facility selection, often need to be solved quickly, easily, and approximately (with limited resources for decision-making) (Moradi & Bidkhori, 2009). These types of problems involve decisions that are more practical and need to be made with less information than multi-plant facility problems.

Various qualitative, quantitative, and hybrid (semi-quantitative) analysis techniques are used for solving the single facility location problem (Moradi & Bidkhori, 2009). There are also techniques that are characterized as subjective analysis, distinguished from qualitative methods because they are based purely on methods such as expert opinion, brainstorming, or Delphi. Examples of quantitative methods, the best known of which is operations research, are cost-benefit analysis and factor rating. Hybrid methods, such as the one adopted in this study, can be used to avoid the disadvantages of qualitative methods that are based on purely subjective criteria and quantitative methods that omit factors that greatly influence the decision but cannot be measured. Examples of these methods include Analytic Hierarchy Process (AHP) (Saaty, 1980), Analytic Network Process (ANP) (Saaty, 1996), The Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE) (Brans, 1982), The Decision Marking Trial and Evaluation Laboratory (DEMATEL) (Gabus & Fontela, 1972), Multiple Criteria Optimization and Compromise Solution - VIseKriterijumska Optimizacija I Kompromisno Resenje- (VIKOR) (Opricović, 1990), The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) (Hwang & Yoon, 1981), The Elimination Et Choice Translating Reality (ELECTRE) (Banayoun, Roy & Sussman, 1966), The Simple Multi-Attribute Rating Technique (SMART) (Edwards, 1971), Weighted Aggregated Sum Product Assessment (WASPAS) (Zavadskas, Turskis, Antucheviciene & Zakarevicius, 2012), Step-Wise Weight Assessment Ratio Analysis (SWARA) (Keršulienė, Zavadskas & Turskis, 2010), Additive Ratio Assessment Method (ARAS) (Zavadskas & Turskis, 2010), Complex Proportional Assessment Method (COPRAS) (Zavadskas, Kaklauskas & Sarka, 1994), Multi-Objective Optimization on the basis of Ratio Analysis (MOORA) (Brauers & Zavadskas, 2006), Interpretive Structural Modelling (ISM) (Warfield, 1974) and Weighted Factor Scoring.

MCDM field examines multiple criteria during the decision-making process in an attempt to find the optimal, or at least reasonable, alternative. This approach is a complicated decision-making tool that integrates both quantitative and qualitative criteria (Mardani et al., 2015) and is a branch of operations research (Sarkar, 2011). In this respect, MCDM means solving in a hybrid way. In support of this assessment, it is seen in the literature that hybrid methods have a wide range of applications in terms of MCDM. Some of the recent research has addressed quite different topics, such as the selection of software, the selection of the distribution system, the optimal stock portfolio selection, sustainable stormwater management, personnel selection, group decision-making, the assessment of the climate crisis, sustainable service quality, the solid waste management, risk analysis, performance measurement, trust estimation technique, land use suitability analysis, cost-benefit analysis, and the safety and sustainability of projects.

MCDM methods have also recently been used in the field of location theory. For instance, some problems such as the site suitability assessment for solar power plants (Islam, Aziz, Alauddin, Kader & Islam, 2024), the plant location selection (Mousavi, Tavakkoli-Moghaddam, Heydar & Ebrahimnejad, 2012), the suitability assessment on site selection for bottom-seeding scallop culture (Zhang, Wang, Li, Zhao & Li, 2024), the photovoltaic power station site selection (Wan, Wu & Dong, 2024), the renewable energy site selection (Shao et al., 2020), the renewable hydrogen production site selection (Serna, Gerres & Cossent, 2023), the site selection of car parking (Dehghani & Soltani, 2023), the integrating flood hazard into site selection of detention basins (Ahmadisharaf, Tajrishy & Alamdari, 2015), the emergency logistics centers site selection (Feng et al., 2023), the selection of the optimal location of construction and demolition waste recycling facilities (Dosal, Viguri & Andrés, 2013), the sensitivity analysis for temporary facility layout planning in construction projects (Jin, Zhang & Yuan, 2018), the retail location selection (Çağrı, Tüysüz & Kahraman, 2013), the problem of vehicle shredding facility location (Simic, Karagoz, Deveci & Aydin, 2021) have been solved through MCDM methods. Raad and Rajendran (2024) proposed a hybrid robust SBM-DEA, multiple regression, and MCDM-GIS model for airport site selection to ensure robustness and to provide solutions that remain feasible and near-optimal even with some changes in input parameters. Geographic information systems-based Pythagorean fuzzy multi-criteria decision analysis was applied in a study on facility selection for waste disposal boxes (Boyacı & Şişman 2024). Chang (2024) by combining subjective and objective weights utilized the MCDM approach to solve emergency location selection problems under spherical fuzzy environments. In a study that put forward a model for the site selection of women's university facilities in different backward locations in the state of West Bengal, India, ten important criteria were identified, trapezoidal neutrosophic numbers were used along with AHP as an MCDM tool to obtain the criteria weights, and TOPSIS and COPRAS were applied to rank the alternatives (Alzahrani et al., 2023). In a study conducted by Petrović et al. (2023) criteria weights were determined using Fuzzy Multi-Criteria Decision-Making (F-MCDM) methods such as Fuzzy Analytic Hierarchy Process (F-AHP), Fuzzy Pivot Pairwise Relative Criteria Importance Assessment (F-PIPRECIA) and Fuzzy Full Consistency Method (F-FUCOM), while the rank of the alternatives was achieved by Fuzzy Weighted Aggregated Sum Product Assessment (F-WASPAS). In a recent study, Aghaloo et al. (2023) used an integrated GIS-based BWM-fuzzy logic method for optimal location selection for the solar-wind hybrid renewable energy systems in Bangladesh.

In the field of health economics, as in any other, striking a balance between cost and benefit is essential. For instance, the goal of pharmacoeconomics, which is a branch of health economics, is to determine, measure, and compare the costs and benefits of pharmaceutical products and services (Rai & Goyal, 2018). As a result of the application of different analysis methods in this area, such as budget-impact analysis, cost-of-illness analysis, cost-comparison analysis, cost-minimization analysis, cost-utility analysis, cost-effectiveness analysis, cost-benefit analysis, and cost-consequence analysis (Thomas, Hiligsmann, John, Al Ahdab & Li, 2019), significant contributions are obtained in terms of the optimum allocation of scarce resources and meeting the needs of society at the maximum level. Similarly, cost and benefit analysis is among the basic elements of the pharmacy management discipline, which focuses on the administration of pharmacies and their operations. Regardless of the discipline in which it is included, certain elements, like opportunity cost, can be measured indirectly in addition to the cost and benefit components that can be calculated directly. Studies carried out in the costs and benefits context will always be incomplete in some aspects unless they take into account the opportunity cost factor. For instance, if the optimal selection is not made when searching for a new community pharmacy location or moving an existing one to a new place, opportunity costs arise.

Various studies have examined the methods and factors that affect the selection of locations for healthcare facilities, pointing out the significance of making use of decision-support tools and taking into account multiple criteria. Vahidnia et al. (2009), for instance, talked about the use of the fuzzy AHP and its variations for hospital facility selection and emphasized the importance of decision support systems in handling ill-structured location selection issues. Furthermore, the integration of spatial analysis and MCDM analysis has been suggested as a useful approach for healthcare facility siting, as shown by Dell'Ovo et al. (2018). This methodology provides a comprehensive framework for evaluating potential site alternatives based on different sources by combining quantitative and qualitative criteria from various fields. Such integrated approaches have gained a significant place in the literature as an important tool to overcome the challenges posed by the complex nature of facility location selection problems and to ensure that the community has effective and efficient access to health services. By emphasizing an integrated approach, this study has provided an important model for tolerating both the complexity of evaluating a large number of criteria and the difficulties in prioritizing a large number of alternatives concerning these often competing criteria. If such effective solutions to the community pharmacy facility location selection problem are not found, it will become common to encounter pharmacy deserts, which, as Pednekar and Peterson (2018) discuss in a study, can occur even in large settlements and refer to large areas where the community's need for access to medicines cannot be met. Without effective tools, such as MCDM, to solve the pharmacy location selection problem, subjective assessments with a high margin for error may become common. As a result of these subjective assessments, large pharmacy deserts that arise due to the preference of many pharmacists for the same or similar location will make access to medicines significantly more difficult for some segments of the population whose location is not preferred by pharmacists for social and demographic reasons, as shown in the study by Wisseh et al. (2020). One of the main reasons that motivated the researcher to carry out this study is the possibility of community pharmacies tending to have such a diseased distribution over time.

The main common point of the studies in the literature that include MCDM approaches focusing on solving location problems can be described as suggesting a practical decision support model for decision-makers by removing them from individual subjective judgments. Although they serve similar basic purposes, quite different methods have been used in location problem studies in different organizational structures. The reason for using different methods in almost all studies is the effort to find the most appropriate method for facility locations, each of which has different characteristics. It can be argued that the methods include two different analysis groups, one group in terms of determining the criteria and the other group in terms of ranking the alternatives. All of the above studies dealing with location problems, no matter how different the methods chosen, have achieved successful results. This is considered to be due to the experience and rigorous efforts of the researchers involved in solving the problem. Complex and specialized methods that can be applied by researchers who know location selection may be impractical for decision-makers and managers. Many of the methods stated above in the literature are included in this context. The importance of this research becomes apparent at this point. Since the pharmacies within the scope of the research are single-plant organizations, they are managed by pharmacists who are not experts in the field of facility location selection and are in a decision-making position. The model proposed by this research is a model that pharmacists can apply without making any changes in the criteria and criteria weights in terms of the simplicity and simplicity of the methods that constitute it, as well as a model that is so adaptable that it allows them to make changes to the criteria if they need to. This study differs from its counterparts in the literature in that it offers a guiding approach for both researchers and practitioners.

3. METHOD

Subjective, objective, expert judgment-based, and integrated methods are used in the literature to determine the weights of the criteria (Keršulienė, Zavadskas & Turskis, 2010). Subjective methods are based on individual assessments of the decision-maker; objective methods are based on analyzing the initial data with mathematical calculations; expert judgment methods are based on experts' assessments that are compatible with each other; and integrated methods are based on the combination of more than one method to determine the weights of the criteria. In this study, a method based on the judgment of pharmacists operating community pharmacies, who are decision-makers, was preferred in determining the criterion weights. Coşkun (2022) determined the factors affecting the selection of a facility site for pharmacies and found that twelve specific criteria were crucial in deciding on the location. In this study, a thirteen-criteria structured form, which was prepared as a result of considering "the location of the nearest pharmacy and competition in the environment" as two different criteria, was used to obtain the judgment of pharmacists. Information was obtained from one hundred pharmacists through a web-based form in the first quarter of 2024. Pharmacists were asked to rank the criteria they should consider when choosing a community pharmacy facility location in order of importance. The results of the judgment, which express the extent to which each criterion is attributed importance by pharmacists, are included in the findings section.

Following the acquisition of all the needed data, SWARA and WASPAS methods were applied in an integrated manner to identify the best alternative. In the first stage, the SWARA method was used to determine the criteria weights, and in the second stage, the WASPAS method was used to rank the alternatives based on the decision.

3.1. SWARA

The SWARA method developed by Keršulienė, Zavadskas and Turskis (2010) is a practically applicable method for determining criteria weights by estimating how much more or less important one criterion is than another. In this respect, the method is a more comprehensive form of the location scoring method, which is one of the easiest and most practical subjective (qualitative) decision-making tools. The method is based on the relative weighting of criteria ranked according to importance through pairwise comparisons.

Step 1:

First, it is necessary to determine how much more important the most important criterion is compared to the criterion with the next highest degree of importance. Then, it should be ascertained how much more important the second-ranked criterion is compared to the third-ranked criterion. In this way, the first stage of the method should be applied by creating a table with the comparative importance of average values (S_j) as a result of considering all criteria in pairs.

Step 2:

In the second stage, coefficients (*kj*) will be determined with the formula below:

$$k_j = s_j + 1 \tag{1}$$

Step 3:

In the third stage, recalculated weights (w_j) will be determined with the following formula with an initial preference value (x_j):

$$w_j = \frac{x_j - 1}{k_j} \tag{2}$$

Step 4:

In the fourth stage, criteria weights (q_j) will be obtained through the formula below:

$$q_j = \frac{w_j}{\sum w_j} \tag{3}$$

As a result, through a series of analyses and mathematical procedures, clear information about the weights of the criteria can be obtained. The information obtained as a result of the application of this method allows conscious and well-founded determination of the optimum alternative in the selection of the pharmacy location.

3.2. WASPAS

The definition of a problem that requires a decision to be made among multiple alternatives according to multiple criteria is realized through various elements such as alternatives, criteria, the relative significance of the criterion, and the preference/performance value of the alternative. In the WASPAS, which is an MCDM method for a problem where the number of criteria is m and the number of alternatives is n, the preference value of alternative i when evaluated according to criterion j can be denoted by x_{ij}, where w_j can be symbolized as the relative significance of the criterion. In this context, the WASPAS method is defined as follows by Zavadskas et. al. (2012).

Step 1:

As a requirement, the relative significances of the criterion (wj) values were previously calculated with the SWARA method. To apply the method, it is first necessary to construct the decision matrix, which is an algebraic matrix formed by the values of the set of criteria associated with each of the alternatives using the following equation:

$$x = \begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{pmatrix} \tag{4}$$

As an initial preference value, X_{nm} in the matrix is the value of a particular criterion (m) for a particular alternative (n) x_{ij} can be determined by applying linear normalization to the initial preference values.

$$\overline{x}_{ij} = \frac{x_{ij}}{\max_i \; x_{ij}} \tag{5}$$

If the criterion is beneficial in terms of contribution to the decision.

$$\overline{x}_{ij} = \frac{\min_i \; x_{ij}}{x_{ij}} \tag{6}$$

If the criterion is non-beneficial in terms of contribution to the decision.

Step 2:

To improve ranking accuracy and decision-making efficiency, the WASPAS method applies a joint criterion for determining the total importance of alternatives and takes into account the contribution at the optimal λ level of the Weighted Sum Model (WSM) and the Weighted Product Model (WPM) for a total evaluation. Therefore, to calculate equation (11), the total relative importance of the alternatives according to the WSM is defined as follows:

$$Q_i^{(1)} = \sum_{j=1}^{n} \overline{x}_{ij} \, w_j \tag{7}$$

The total relative importance of the alternatives is expressed as follows by the WPM.

$$Q_i^{(2)} = \prod_{j=1}^{n} (\overline{x}_{ij})^{w_j} \tag{8}$$

Step 3:

Variances of estimates of alternatives in the WASPAS method depend on variances of the coefficient λ as well as the Weighted Sum Model and the Weighted Product Model (Zavadskas et. al., 2012). At this stage, the optimal value of λ needs to be found to ensure maximum accuracy of the estimation and to find the minimum distribution of variance. Zavadskas et. al. (2012) calculate the maximum value of λ via the following equation:

$$\lambda = \frac{\sigma^2(Q_i^{(2)})}{\sigma^2(Q_i^{(1)}) + \sigma^2(Q_i^{(2)})} \tag{9}$$

It should be noted that the optimal λ value must be calculated separately for each alternative. Also, to calculate the optimal λ, estimates of variances of normalized initial criteria values are necessary. Zavadskas et. al. (2012) perform this calculation with the following equation:

$$\sigma^2(\bar{x}_{ij}) = (0.05\ \bar{x}_{ij})^2 \tag{10}$$

Step 4:

$$Q_i = \lambda Q_i^{(1)} + (1\text{-}\lambda)Q_i^{(2)} = \lambda \sum_{j=1}^{n} \bar{x}_{ij}\ w_j + (1\text{-}\lambda)\prod_{j=1}^{n} (\bar{x}_{ij})^{w_j}, \lambda = 0, 0.1, ..., 1. \tag{11}$$

The most important outcome of an MCDM model is the ability to correctly rank the decision alternatives whose relative importance is determined compared to each other. A decision model that fails to produce this output accurately will be a useless method that is far removed from the purpose it serves. To provide the accuracy of the results in this research, first, the optimal λ values for each alternative are calculated, and then the relative significances of alternatives corresponding to the optimal λ values are determined. Consequently, all alternatives were ranked according to their relative significance values, and the alternative with the highest value was ranked first.

3.3. Approach to Integrating SWARA-WASPAS Methods

The criteria for deciding on a new facility can be categorized under three categories: cost, demand, and purely personal considerations (Greenhut, 1956). The integrated method that blends the criteria of these three different categories in the right proportion has a critical role in achieving success. Considering the complex and uncertain structure of MCDM problems, weight assessment and ranking the alternatives appear as two essential analysis steps. It is unlikely for a decision-maker who makes a mistake in either of these two analysis processes to solve the problem correctly.

SWARA method, in which the criteria determined by consulting experts in the first stage are weighted in the second stage, is one of the most effective methods for evaluating the criteria (Thakkar, 2021a). Similarly, the WASPAS method provides decision-makers with an advantage over some other methods that have low success in ranking, which is the basic function of such methods, due to its potential to increase the accuracy of the ranking of alternatives -by taking into account the optimal lambda value- (Thakkar, 2021b). Therefore, these two methods were used in an integrated approach in this research.

The integration of the SWARA method with the WASPAS method is increasingly recognized as an effective approach to MCDM in various fields. For instance, Baç (2020) used the integration of these two methods to evaluate smart card systems in public transportation within the scope of group decision-making. Similarly, Singh and Modgil (2020) successfully applied the integrated SWARA-WASPAS approach to optimize supplier selection. Within the scope of a study on sustainable health financing models, a scenario-based analysis method that considers these two methods with an integrated approach has been introduced to the literature (Hashemkhani Zolfani et al., 2019). Zavadskas, Đalić and Stević (2021) created an original three-method integrated model that includes the Data Envelopment Analysis (DEA), SWARA, and WASPAS methods. In this context, DEA was used as a linear programming model to determine the efficiency of five agricultural products concerning eight inputs and one output. Then SWARA was used to determine the weight values of the criteria, and WASPAS was used for the final ranking of the alternatives. Vinchurkar and Samtani (2019) concluded that the integration of SWARA and WASPAS methods can be used successfully in a comprehensive study in which they tested the integration of multiple methods in pairs during the analysis of an MCDM problem. In a recent study, a new methodology combining SWARA and WASPAS methods under a Fermatean fuzzy environment was proposed for sustainable waste management (Köse, Ayyıldız & Çevikcan, 2024). Anjum et al. (2024) in a study applied the SWARA-WASPAS model to to spherical fuzzy sets (SFSs), thus identifying and guiding the uncertainty present in decision-making, in contrast to conventional evaluations. A recent study proposed a comprehensive and integrated hybrid fuzzy decision-making framework for evaluating hydrogen production technologies (Dehshiri et al., 2024). In this context, the Fuzzy SWARA approach determined the importance of indicators and the Fuzzy WASPAS approach ordered technologies. Alrasheedi et al. (2023) aimed to propose an integrated multi-criteria group decision-making (MCGDM) approach with intuitionistic fuzzy information through the integration of SWARA and WASPAS methods and select the optimal renewable energy source for multiple facets of sustainability criteria. Sharma, Sohani and Yadav (2023) proposed a SWARA-WASPAS-based fuzzy model that helps to identify the role of lean enablers in enhancing supply chain agility, which is a new concept that links both lean and agility. Bouraima et al. (2023) proposed the integration of WASPAS with SWARA in a spherical fuzzy (SF) environment to handle complex group decision-making problems. The fact that it has been successfully applied in many studies reveals that the integration of SWARA and WASPAS methods generates effective results.

3.4. Selection of the Alternatives

The methods and approaches used to solve MCDM problems differ significantly from each other. However, it can be argued that these methods and approaches have certain common characteristics. In this context, it is stated that the common characteristics of the MCDM problems include setting multiple objectives, which refers to the need for the decision maker to set different criteria according to the special considerations of each problem; conflict among criteria, which refers to the fact that in some cases it may be necessary to compromise others while trying to meet one criterion; incommensurable units, which refers to the fact that each criterion has a different scale or measurement method; and design or selection, which refers to two different approaches such as designing the optimal alternative or selecting the optimal one among the finite alternatives (Hwang & Yoon, 1981, p.2). It is possible to see the influence of these four common characteristics in the selection of a community pharmacy facility site. Each decision-maker will be able to consider a large number of criteria in the selection process. In the meantime, different criteria-set preferences are likely to emerge. Some key conflicts can arise between criteria, such as being willing to pay more rent to select a facility that has the potential to attract more customers. To measure criteria such as competitiveness, consumer accessibility, and infrastructure quality, creative and original approaches must be developed. To reach the optimal community pharmacy alternative, a model can be designed and the most suitable facility can be searched for this model, or the decision can be made by determining the most optimal one among the predetermined possible facility alternatives. Ten facility locations that are alternatives to each other were determined in this study, where the second approach was preferred.

The alternative community pharmacy locations subject to the research are located in or bordering the Çankaya District of Ankara City. To better test the functionality of the research model, ten different community pharmacy locations with different qualities were determined. As can be seen from the characteristics of the pharmacies included in this study, the expected benefits and costs of the criteria conflict with each other. In other words, a high level of benefit from one criterion may lead to a decrease in the benefit of another criterion. For example, the expected benefit from an alternative with a high level of dermo-cosmetic product sales potential decreases due to the reflection of this potential as an increase in the rent of the relevant workplace. This is inherent in the MCDM approach, which makes it difficult to decide on the best pharmacy facility.

The main reason why the pharmacies included in the research are preferred among many pharmacies is that the features of each of them are evaluated in a different category that will deeply affect management strategies. For example, the reason for choosing and management strategies of a pharmacy that is located in a shopping mall should be evaluated in one category; a pharmacy located directly across the street from a hospital should be evaluated in a different category; and a pharmacy that serves only a specific and small group of costumers should be evaluated in a different category. The alternative workplaces included in the study based on these principles will ensure that the ranking that results from the analysis of the study is realistic and that the method will guide practitioners. This approach will contribute significantly to the research in terms of the diversity of findings and interpretations.

All data obtained about the pharmacies within the scope of the study was collected in the first quarter of 2024 after ethics committee permission was obtained. Some of the information about the pharmacies included in the study regarding the research criteria, such as rental price, dermo-cosmetic product sales potential, and the number of customers obtaining pharmaceutical products, was obtained by collecting information directly from the pharmacist administering the pharmacy. Information on other criteria such as proximity to health institutions, proximity to businesses and places with crowds of people, the number of people passing by the location, location of the nearest pharmacy, traffic density, parking availability, competition in the environment, accessibility for elderly, and disabled people were determined by the researcher through on-site measurements. While the data for the criteria of socio-cultural structure and safety of the environment were determined by the subjective evaluation of the researcher, information on the criterion of location in developed or developing residential areas was obtained from the results of studies in the literature and reports of official institutions (Yüceşahin & Tüysüz, 2011; Ankara Development Agency, 2023). Data related to the infrastructure facilities criterion was obtained from the websites of the companies that provide information systems infrastructure services to the pharmacies included in the study. These websites are different for each pharmacy, including those that provide the highest speed and uninterrupted service among all companies providing wide-band internet to the pharmacy's location.

The most prominent characteristic of the first alternative determined on these grounds is that it is a district pharmacy where the ownership of the workplace has belonged to the same pharmacist for many years. The majority of the 6346 customers who have preferred the pharmacy in the calendar year 2023 have been using this pharmacy for their pharmaceutical needs for a long time and have developed good relations with the owners. Although the location of the pharmacy is in Oğuzlar District, which is a developed place, it is a relatively out-of-the-way place, and the probability of a customer who does not know its location heading here for medicine needs is quite low. The sales potential of dermo-cosmetic products is almost non-existent. The second pharmacy is situated on the busiest thoroughfare in the District of Bahçelievler. In the calendar year 2023, 128567 customers have used this pharmacy to obtain medicines or for non-drug needs. Due to being situated near crowded cafés and restaurants, it has a significant potential for sales of dermo-cosmetic products. This advantage is significant enough to compensate for the disadvantages of a high rental price.

The third alternative, which operates in the Öveçler District, is located on a main street with relatively low pedestrian traffic but high vehicle traffic. In the past year, the pharmacy served 18095 customers in total. The sales potential for dermo-cosmetic products remains low when compared to other alternatives. Alternative number four is located close to the busiest avenue in Kızılırmak District and on a street that intersects with this avenue. Due to its location, it attracts customers more interested in purchasing dermo-cosmetic goods than in getting prescription medicines. In the calendar year 2023, this pharmacy has been selected by 25052 customers in total. The high rent creates a disadvantage, but the ownership of the workplace by the pharmacist limits this disadvantage.

The fifth pharmacy is located in the Çiğdem District. The most distinctive feature of this pharmacy is that there are no health institutions nearby, and its market is made up of district residents. Although the number of competing pharmacies is higher than some other alternatives, it has been evaluated that the size of the district is sufficient to raise the income of all competitors to a sufficient level. A total of 15855 customers have used this pharmacy in the calendar year 2023, almost equally for medicines and non-medicines. The sixth alternative is located on the busiest street in the Balgat District, close to a well-known private health institution, and in a location where both pedestrian and vehicular traffic are at a significant level. Shortly before this scientific study began, the pharmacist took over the pharmacy from another pharmacist who wanted to leave it due to a decrease in customer volume caused by managerial issues. The total number of customers served in the calendar year 2023, approximately 6349 people, is considered to be well below the potential of the location of the pharmacy.

The seventh pharmacy is located in a shopping mall in the Balgat District. In this respect, it has a market structure quite different from other alternatives. While the number of people coming for medicines is not low compared to its potential, the number of customers coming for dermo-cosmetic products is quite high. A total of 44920 people received services from the pharmacy in the calendar year 2023. The eighth-ranked pharmacy is located in the Ehlibeyt District, facing the main street. The most prominent feature is that it is located at the intersection of three major districts with heavy vehicle traffic. Its proximity to businesses and restaurants can be considered an important advantage. The advantages of its location are clouded by the fact that the average number of people passing by in a working day is relatively low and the sales potential of dermocosmetic products is not at the expected level. There were a total of 10,938 customers in the calendar year 2023.

The ninth pharmacy is located on the main street in the İşçi Blokları District. It is located right across from a private health institution. There is a significant amount of pedestrian traffic and a high amount of vehicular traffic in front of it. There is significant sales potential for both pharmaceuticals and dermocosmetic products. It is noteworthy that the number of people receiving service in both product categories is equal to each other. The number of people served by this pharmacy in the calendar year 2023 is 61332. The last pharmacy is located in the Tepealtı District. The main market for this pharmacy is the primary health care facility located directly opposite. For the pharmacy, this organization is of such great importance that it was decided to move the pharmacy when it was certain that the health institution would be relocated. In this context, it can be argued that there is a symbiotic relationship between the health institution in question and the pharmacies around it. The total number of people served by this pharmacy, which has the advantage of low rent, in the calendar year 2023 was 28532. It can be stated that the number of people served in the pharmaceutical category is relatively high due to its proximity to the health institution.

3.5. Ethical Permissions of the Study

The documents related to the application file of the study were examined by the Non-interventional Research Ethics Committee of the Yüksek İhtisas University Non-interventional Research Ethics Committee, taking into account the rationale, purpose, approach, and methods of the study, and were found appropriate on December 7, 2023, with the number 2023/03 /46. It has been decided by the ethics committee that there is no ethical or scientific drawback to conducting the study in the places specified in the application file.

4. FINDINGS

The criteria to be considered when selecting a community pharmacy facility in this study were determined to consist of the twelve criteria discovered in a previous study (Coşkun, 2022). Unlike the aforementioned research, this study included thirteen criteria in total, since two of the criteria—"competition in the environment" and "location of the nearest pharmacy"—represent two distinct attributes. Pharmacists were consulted to identify and rank the most important criteria for deciding on a pharmacy location. They were asked to indicate which of these thirteen criteria they considered important when choosing a community pharmacy facility. Figure 1 ranks the main criteria to take into account when selecting a community pharmacy facility site in this research. While it was determined that the most important criterion was proximity to health institutions, the least important was accessibility for the elderly and disabled people. It is striking that there is a significant difference in importance between the most important criterion, proximity to health institutions, and the second, proximity to businesses and places with crowds of people.

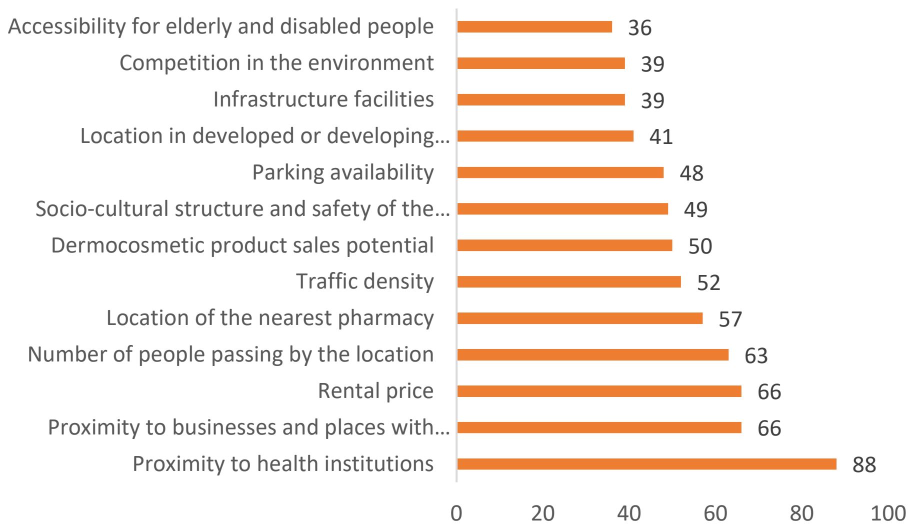

Figure 1: Ranking the Importance of Criteria in the Selection of a Community Pharmacy Facility

After determining the criteria that are important in community pharmacy facility selection, the SWARA method was used to weight these criteria. The comparative importance of average values, coefficients, and recalculated weights that must be determined first to obtain the criteria weights are given in Table 1. The weights calculated separately for the criteria of proximity to health institutions, proximity to businesses and places with crowds of people, rental price, number of people passing by the location, location of the nearest pharmacy, traffic density, dermo-cosmetic product sales potential, socio-cultural structure and safety of the environment, parking availability, location in developed or developing residential areas, infrastructure facilities, competition in the environment, and accessibility for elderly and disabled people are $w1 = 0{,}105$; $w2 = 0{,}086$; $w3 = 0{,}086$; $w4 = 0{,}084$; $w5 = 0{,}079$; $w6 = 0{,}075$; $w7 = 0{,}074$; $w8 = 0{,}073$; $w9 = 0{,}072$; $w10 = 0{,}068$; $w11 = 0{,}066$; $w12 = 0{,}066$; $w13 = 0{,}064$ respectively.

Table 1: Criterion Weights

Criteria	Pairwise Comparative importance of average value	Coefficient	Recalculated weight	Weight
x1: Proximity to health institutions		1	1	0,105
x2: Proximity to businesses and places with crowds of people	0,22	1,22	0,82	0,086
x3: Rental price	0	1	0,82	0,086
x4: Number of people passing by the location	0,03	1,03	0,8	0,084
x5: Location of the nearest pharmacy	0,06	1,06	0,75	0,079
x6: Traffic density	0,05	1,05	0,72	0,075
x7: Dermocosmetic product sales potential	0,02	1,02	0,7	0,074
x8: Socio-cultural structure and safety of the environment	0,01	1,01	0,69	0,073
x9: Parking availability	0,01	1,01	0,69	0,072
x10: Location in developed or developing residential areas	0,07	1,07	0,64	0,068
x11: Infrastructure facilities	0,02	1,02	0,63	0,066
x12: Competition in the environment	0	1	0,63	0,066
x13: Accessibility for elderly and disabled people	0,03	1,03	0,61	0,064

To create the decision-making matrix, ten locations that were used as community pharmacies during the research and had quite different attributes from each other were identified. The *xij* values in the matrix represent the performance of alternative *i* concerning criterion *j*.

Table 2: Criteria Evaluation Principles

Criteria	Description	Unit
x1: Proximity to health institutions	The distance of each alternative community pharmacy to the nearest health institution	Meters
x2: Proximity to businesses and places with crowds of people	The distance of each alternative to these areas	Meters
x3: Rental price	The monthly rent of the pharmacy	Turkish Liras
x4: Number of people passing by the location	The average number of people passing by the pharmacy within a working day	The number of people
x5: Location of the nearest pharmacy	Distance of the nearest pharmacy	Meters
x6: Traffic density	The average number of cars passing in front of the pharmacy during a working day	The Number of cars
x7: Dermocosmetic product sales potential	Monthly sales potential	Turkish Liras
x8: Socio-cultural structure and safety of the environment	The socio-cultural structure and safety of the environment	Subjective assessments
x9: Parking availability	The average time to find an empty parking space during a working day	Minutes
x10: Location in developed or developing residential areas	The degree of development of the location of the pharmacy	Three different categories
x11: Infrastructure facilities	Location-based internet speed	Megabits per second
x12: Competition in the environment	Pharmacies in a position to compete with the relevant pharmacy	The number of pharmacies
x13: Accessibility for elderly and disabled people	Specially allocated or suitable parking areas for disabled or elderly people	The number of parking areas

The proximity to health institutions criterion refers to the distance in meters of each alternative community pharmacy to the nearest health institution (where it is a primary stakeholder). The criterion of proximity to businesses and places with crowds of people was also measured by the distance of each alternative to these areas in meters. The rental price is the monthly rent of the pharmacies in Turkish Lira. The average number of people passing by the pharmacy within a working day was considered another criterion. The location of the nearest pharmacy was also measured in meters. Traffic density is calculated as the average number of cars passing in front of the pharmacy during a working day. Dermocosmetic product sales potential was obtained in the Turkish lira on a monthly average by directly asking the pharmacists managing the relevant pharmacy. The socio-cultural structure and safety of the environment were based on a subjective assessment. Parking availability refers to the average time in minutes to find an empty parking space during a working day. The location of the pharmacy in a developed or developing region was evaluated according to the results of the studies in the literature. The degree of development of the location of the pharmacy was evaluated according to the results of the studies in the literature and reports of official institutions (Yüceşahin & Tüysüz, 2011; Ankara Development Agency, 2023). Information systems infrastructure quality was obtained on a location-based basis from organizations providing services. The number of pharmacies in a position to compete with the relevant pharmacy was added to the model as a different criterion. Finally, the number of specially allocated or suitable parking areas where disabled or elderly people can park their cars is included in the evaluation.

Table 3: Decision-Making Matrix

Alternatives ai	Criteria values x_{ij}												
	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}
a_1	525	230	12000	155	292	336	122	3	3	3	85	14	5
a_2	650	1	150000	2250	193	2432	57614	20	32	1	88	11	2
a_3	550	280	15000	226	257	1067	720	11	5	3	86	1	6
a_4	450	35	110000	450	453	974	12896	19	24	1	101	5	1
a_5	750	10	15000	357	1	968	5157	6	17	2	97	2	3
a_6	170	15	15000	550	144	1890	1215	23	21	2	62	15	1
a_7	350	25	120000	800	516	445	36549	18	16	2	101	1	16
a_8	1045	54	12000	410	280	1145	1312	21	12	3	85	6	2
a_9	40	15	80000	470	441	2136	30445	24	29	2	100	2	1
a_{10}	15	550	10000	170	17	613	3514	9	6	2	71	8	4

This section analyzes an MCDM problem to correctly rank the alternatives using the WASPAS method after the relative importance of the criteria has been determined. There are ten alternatives and thirteen criteria in the MCDM problem that this study examines. By compiling each alternative's performance (preference) values based on each criterion, a decision-making matrix was created. Table 4 shows the initial decision-making matrix consisting of normalized performance values.

Table 4. Initial Normalized Decision-Making Matrix

Alternatives ai	Normalized criteria values $\bar{x}_{ij}$												
	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$	$\bar{x}_5$	$\bar{x}_6$	$\bar{x}_7$	$\bar{x}_8$	$\bar{x}_9$	$\bar{x}_{10}$	$\bar{x}_{11}$	$\bar{x}_{12}$	$\bar{x}_{13}$
a_1	0,029	0,004	0,833	0,069	0,566	0,138	0,002	1,000	1,000	0,333	0,842	0,071	0,313
a_2	0,023	1,000	0,067	1,000	0,374	1,000	1,000	0,150	0,094	1,000	0,871	0,091	0,125
a_3	0,027	0,004	0,667	0,100	0,498	0,439	0,012	0,273	0,600	0,333	0,851	1,000	0,375
a_4	0,033	0,029	0,091	0,200	0,878	0,400	0,224	0,158	0,125	1,000	1,000	0,200	0,063
a_5	0,020	0,100	0,667	0,159	0,002	0,398	0,090	0,500	0,176	0,500	0,960	0,500	0,188
a_6	0,088	0,067	0,667	0,244	0,279	0,777	0,021	0,130	0,143	0,500	0,614	0,067	0,063
a_7	0,043	0,040	0,083	0,356	1,000	0,183	0,634	0,167	0,188	0,500	1,000	1,000	1,000
a_8	0,014	0,019	0,833	0,182	0,543	0,471	0,023	0,143	0,250	0,333	0,842	0,167	0,125
a_9	0,375	0,067	0,125	0,209	0,855	0,878	0,528	0,125	0,103	0,500	0,990	0,500	0,063
a_{10}	1,000	0,002	1,000	0,076	0,033	0,252	0,061	0,333	0,500	0,500	0,703	0,125	0,250

Table 5 exposes how the best option changes based on the different values of λ, which range from 0 to 1. This means that selecting a random λ value significantly reduces the likelihood of deciding on the best alternative.

Table 5: Ranking of Alternatives Based On Different λ Values.

Alternatives a_i	Relative significances of alternatives Q_i										
	λ= 0	λ= 0.1	λ= 0.2	λ= 0.3	λ= 0.4	λ= 0.5	λ= 0.6	λ= 0.7	λ= 0.8	λ= 0.9	λ= 1.0
a_1	0,127	0,153	0,178	0,204	0,230	0,255	0,281	0,307	0,333	0,358	0,384
a_2	0,268	0,293	0,317	0,342	0,367	0,391	0,416	0,440	0,465	0,489	0,514
a_3	0,163	0,185	0,206	0,227	0,248	0,269	0,290	0,311	0,332	0,353	0,374
a_4	0,172	0,186	0,201	0,216	0,230	0,245	0,260	0,274	0,289	0,304	0,318
a_5	0,147	0,163	0,180	0,196	0,212	0,228	0,245	0,261	0,277	0,293	0,310
a_6	0,170	0,181	0,192	0,202	0,213	0,224	0,235	0,245	0,256	0,267	0,278
a_7	0,255	0,273	0,292	0,310	0,329	0,348	0,366	0,385	0,403	0,422	0,440
a_8	0,148	0,163	0,177	0,192	0,207	0,222	0,237	0,251	0,266	0,281	0,296
a_9	0,272	0,285	0,297	0,310	0,323	0,335	0,348	0,361	0,374	0,386	0,399
a_{10}	0,171	0,193	0,215	0,236	0,258	0,280	0,302	0,323	0,345	0,367	0,389

From Figure 2, it is possible to determine how the ranking of alternatives is affected when λ takes different values such as 0, 0.1, 0.2,,..1 according to these different λ values. This corroborates the mathematical prediction that varying λ values will result in varying contributions from the WSM and the WPM to the relative significance of alternative values computed by Equation 1.

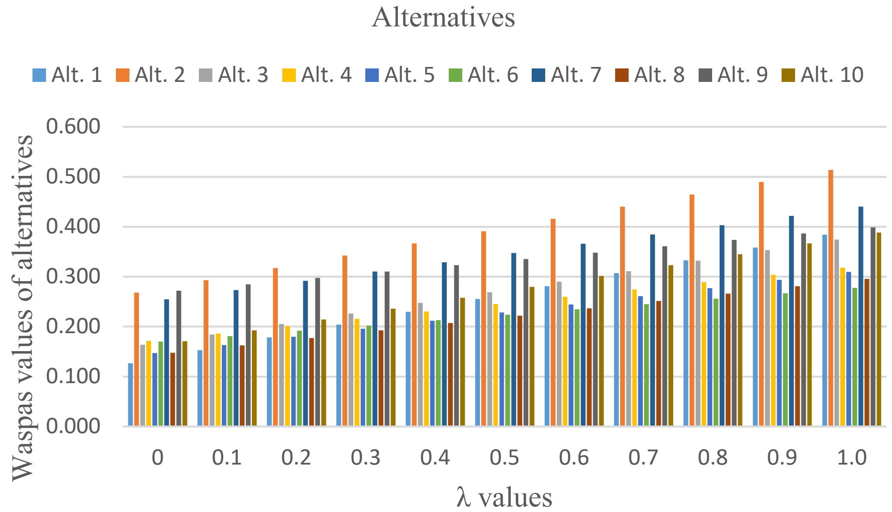

Figure 2: Ranking of Alternatives Based on λ Values.

The relative significance of the alternatives is shown in Figure 3. These values were calculated with a similar approach to formula number (10), by determining the confidence intervals with a credibility of q = 0.05.

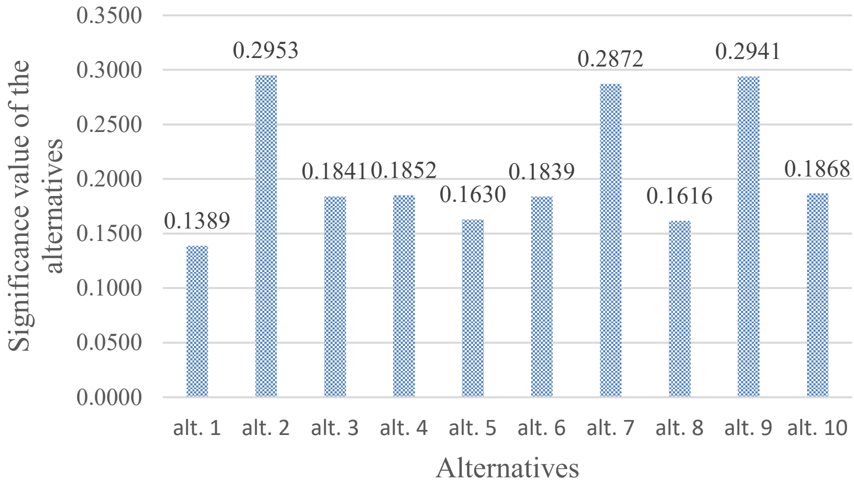

Figure 3: The Relative Importance of Alternatives [a]

[a] Confidence intervals were determined with the credibility of q=0.05.

To determine the best alternative under these circumstances, the optimal value of λ must be calculated. After calculating the optimal λ (Eq. 7), the estimated optimal values (Table 6) are used to rank the alternatives. In this context, from highest to lowest relative significance values, the alternatives were ranked. The ranking order of alternatives is given below the table.

Table 6: Ranking of Alternatives Applying Optimal λ

Alternatives a_i	**Optimal λ**	**Relative significances of alternatives** Q_i
a_1	0,0471	0,1389
a_2	0,1098	0,2953
a_3	0,0981	0,1841
a_4	0,0922	0,1852
a_5	0,0986	0,1630
a_6	0,1276	0,1839
a_7	0,1750	0,2872
a_8	0,0929	0,1616
a_9	0,1736	0,2941
a_{10}	0,0725	0,1868
Ranking order of alternatives [a]	$a_2 \succ a_9 \succ a_7 \succ a_{10} \succ a_4 \succ a_3 \succ a_6 \succ a_5 \succ a_8 \succ a_1$	

[a] The symbol "≻" is used as in the study conducted by Zavadskas et. al. (2012).

In this study, which focuses on reaching the best option by determining optimal λ values according to certain parameters, the best community pharmacy location was determined as alternative number 2. The second-ranked option was found to be the alternative numbered 9. The other options are ranked 7th, 10th, 4th, and 3rd, in order, based on the ranking that served as the foundation for the decision. The last alternative on the list was number 1. It is the degree of importance of each criterion relative to the other criteria that influences the criterion ranking. The alternatives are ranked as a function of the criteria weights of this research. Each alternative is ranked according to its criterion performance when all criteria are considered. Based on the level of overlap with the average annual number of people served by pharmacies (thus achieving one of the main objectives of the organization), it can be concluded that this study's integrated MCDM approach was effective in prioritizing the alternatives and identifying the best one.

5. CONCLUSION AND DISCUSSION

Studies on MCDM problems aim to determine the optimal solution. The optimal solution for the MCDM problem is the one that maximizes the values of each alternative's performance (preference) based on each criterion. This optimization method won't generally work because of the conflicting objectives (Hwang & Yoon, 1981, p.18). Since it is not possible to find a theoretically perfect decision alternative, that is, has the highest value in terms of each criterion, with exceptions, it is necessary to turn to the alternative that provides the total benefit (preferred or best solution), based on the relative importance of the criteria.

Two fundamental approaches can be used to solve an MCDM problem: either determine the optimal choice and put effort toward obtaining it, or select the best option from the list of available alternatives. It is possible to design a community pharmacy facility that maximizes the expected benefits from all criteria and minimizes costs. Even if an optimal community pharmacy facility can somehow be designed, it will most likely not be possible in practice to find a workplace suitable for this design. Even if it is thought for a moment that a workplace with optimal criterion values exists, the possibility of it being rented or sold in the required period is very low, which will inevitably push decision-makers to other searches. Therefore, instead of designing the optimal community pharmacy facility and pursuing this dream, the right approach is to identify various alternative workplaces and choose the most appropriate one among them. Based on this, this study, instead of designing the optimal community pharmacy location, was aimed to determine the best among ten alternative pharmacy facility locations that are located very close to each other but have different qualities.

The reason why workplaces currently used as pharmacies are preferred instead of workplaces for rent or sale that are suitable for the establishment of a new pharmacy is to determine how successfully the model of this research can be used in working life. For this purpose, while collecting data on community pharmacies, the annual customer potential of these facilities was also obtained separately in terms of the number of people based on pharmaceutical and non-pharmaceutical purchases, since facilities that are currently pharmacies were preferred. Although the number of people served is not an exact indicator of profitability for community pharmacies, it is obvious that it is the most important indicator. Considering that one of the main objectives of businesses is to serve society, the importance of the number of people served once again emerges. Therefore, it would be an appropriate approach to rank facility alternatives in a preliminary order according to the number of people served.

When the alternatives included in this research are ranked according to the number of people served, it is expected that the second alternative will be in the first place, the ninth alternative will be in the second place, and the seventh alternative will be in the third place. The remaining alternatives are expected to be ranked as 10, 4, 3, 5, 8, 6, and 1, respectively. The ranking realized as a result of the analysis of the research model is exactly in line with what is expected, except for the position of an alternative. As a result of the analysis of the integrated model, alternative number six, which was expected to be ranked seventh during the decision, was ranked ninth when the number of people served was considered based on actual data. When the possible reasons for this situation were analyzed, it was revealed that this deviation was not due to the model or methodology of this research but that the community pharmacy in question had previously lost customers due to poor management and was therefore not where it should be in the ranking. At this point, it has become clear that determining the facility correctly is as important a factor as successfully managing the community pharmacy, as is predominantly emphasized in the literature.

The selection of a pharmacy location is not only of concern to pharmacy staff but also to almost all of society, as it is a crucial issue that significantly affects healthcare delivery and patient outcomes. There are many factors to consider when choosing a community pharmacy facility location, such as population density, the presence of physician offices, median household income, pharmacy operation type, and retail locations (Chen et al., 2023). In addition, specific factors such as ethical considerations and professional values are also highly important in community pharmacy site selection to ensure patient safety and quality of care (Cooper et al., 2009). When selecting a community pharmacy facility location, the decision-maker should act in an empathetic manner, being aware of the criteria that customers consider, such as convenience, physical environment, sales promotions, qualified pharmacists, and customer service influence (Ghattas & Al-Abdallah, 2020). Although many factors are likely to influence the decision during such a selection, some of these factors have almost no potential to change our decision. Therefore, it is important to focus on factors that have a high potential to influence the decision-maker's selection to avoid wasted effort. The critical factors used in Coşkun's (2022) study, which yielded remarkably successful results, similarly contributed to obtaining successful results in this study.

When solving a community pharmacy facility location selection problem, it is important to determine the correct criteria and weight them appropriately, as well as to correctly select the alternative that will be decided upon as a result of evaluating these criteria. Sometimes, situations arise where it is more critical to focus on the method and model rather than the criteria because while the criteria can be easily changed, changing the method and model can be a troublesome and costly issue. This study, which has this perspective and focuses on the method and model rather than the criteria, has provided quite successful results. The criteria used in this study, which were introduced to the literature as a result of recent research, are not indispensable or unchangeable for future research, although they produce accurate results in this study. Future researchers or pharmacists trying to decide on a community pharmacy facility location can voluntarily reduce their number, add new ones, or even change the content of the criteria. When conducting studies adopting the methodology and model of this research in various countries with different economic and cultural characteristics, such criteria changes may become a necessity rather than an option. This also constitutes the main limitation of this study. At this point, it should be emphasized that when such a criterion-based change is made, whether voluntary or compulsory, it is important to verify the reliability of the results with a method similar to the one used in this study.

An important advantage of using an integrated MCDM approach in this research is that different methods can be preferred instead of one or both of the two methods used. According to this point of view, what is important in choosing a community pharmacy facility location is to adopt an integrated MCDM approach, which has been confirmed by different studies and different methods in the literature to be effective. One of the most important results of this study is that this perspective, which has been previously confirmed in different single-facility location problems, can produce similarly accurate outcomes for community pharmacies.

This study shows that the SWARA-WASPAS integrated model for community pharmacy facility selection has produced successful results. When selecting a new or trying to determine whether an existing facility location is suitable, the model is cost-effective, low-specialization, time-saving, fast, practical, and easy to use. This model, which successfully solved the community pharmacy facility location problem, is considered to make a significant contribution to the literature and guide future research since it can be easily adapted to many single-plant organizational structures. Future research may utilize the MCDM approach to develop a model for multi-plant organizations. They may also develop different alternatives for solving the problem by integrating various methods.

6. CONFLICT OF INTEREST STATEMENT

There is no conflict of interest as it is prepared by a single author.

7. FINANCIAL SUPPORT

No funding or support was used in this study.

8. AUTHOR CONTRIBUTIONS

This study was prepared by one author.

9. ETHICS COMMITTEE STATEMENT AND INTELLECTUAL PROPERTY COPYRIGHTS

The principles of the ethics committee were followed in the study and necessary permissions were obtained in accordance with the principles of intellectual property and copyright.

10. REFERENCE

Aghaloo, K., Ali, T., Chiu, Y. R., & Sharifi, A. (2023). Optimal site selection for the solar-wind hybrid renewable energy systems in Bangladesh using an integrated GIS-based BWM-fuzzy logic method. *Energy Conversion and Management, 283*, 116899.

Ahmadisharaf, E., Tajrishy, M., & Alamdari, N. (2015). Integrating flood hazard into site selection of detention basins using spatial multi-criteria decision-making. *Journal of Environmental Planning and Management, 59(8)*, 1397–1417.

Alrasheedi, A. F., Mishra, A. R., Rani, P., Zavadskas, E. K., & Cavallaro, F. (2023). Multicriteria group decision-making approach based on an improved distance measure, the SWARA method and the WASPAS method. *Granular Computing, 8(6)*, 1867–1885.

Alzahrani, F. A., Ghorui, N., Gazi, K. H., Giri, B. C., Ghosh, A., & Mondal, S. P. (2023). Optimal Site Selection for Women University Using Neutrosophic Multi-Criteria Decision Making Approach. *Buildings, 13(1)*, 152.

Anjum, M., Min, H., Sharma, G., & Ahmed, Z. (2024). Advancing sustainable urban development: Navigating complexity with spherical fuzzy decision making. *Symmetry*, *16(6)*, 670.

Ankara Development Agency. (2023). Ankara regional plan. Accessed from https://kutuphane.ankaraka.org.tr/upload/dokumandosya/35_ankara-bolge-plani-2014-2023.pdf on April 05, 2024.

Baç, U. (2020). An integrated swara-waspas group decision making framework to evaluate smart card systems for public transportation. Mathematics, 8(10), 1723. 1-23.

Banayoun, R., Roy, B., & Sussman, N. (1966). Manual de reference du programme electre (French) [electre program reference manual]. In *Note de Synthese et Formation 25. Direction Scientifique SEMA*, Paris, France.

Bouraima, M. B., Qiu, Y., Ayyıldız, E., & Yıldız, A. (2023). Prioritization of strategies for a sustainable regional transportation infrastructure by hybrid spherical fuzzy group decision-making approach. *Neural Computing & Applications, 35(24)*, 17967–17986.

Boyacı, A. C., & Şişman, A. (2024). Location selection for waste disposal boxes: a geographic information systems based Pythagorean fuzzy multi-criteria decision analysis. *International Journal of Environmental Science and Technology*, 1-16.

Brandeau, M. L., & Chiu, S. S. (1989). An overview of representative problems in location Research. *Management Science, 35(6)*, 645–674.

Brauers, W. K. M., & Zavadskas E. K. (2006) The MOORA method and its applications to privatization in a transition economy. *Control and Cybernetics, 35*, 445-469.

Brans, J. P. (1982). *L'ingénierie de la décision: l'élaboration d'instruments d'aide a la décision. Méthode PROMETHEE*. Université Laval, Faculté des Sciences de L'administration, Québec, QC, Canada.

Carrier, R. E., & Schriver, W. R. (1968). Location theory: an empirical model and selected findings. *land economics, 44(4)*, 450-460.

Chang, K. H. (2024). Combining subjective and objective weights considerations to solve the emergency location selection problems under spherical fuzzy environments. *Applied Soft Computing, 153*, 111272.

Chen, J., Huang, Y., Chan, H., Chen, M., & Ho, Y. (2023). Mapping real-world data to self-reported information to explore determinants of location selection for community pharmacies in Taiwan. *Journal of Multidisciplinary Healthcare, 16,* 971-981.

Cooper, R., Bissell, P., & Wingfield, J. (2009). `Islands' and `doctor's tool': the ethical significance of isolation and subordination in UK community pharmacy. *Health an Interdisciplinary Journal for the Social Study of Health Illness and Medicine, 13(3),* 297-316.

Coşkun, T. İ. (2022). Eczane kuruluş yeri seçimini etkileyen faktörlerin çok kriterli karar verme tekniklerinden wıngs ve dematel yöntemleriyle değerlendirilmesi, *Eskişehir Osmangazi Üniversitesi İİBF Dergisi, 17(2)*, 295 –310.

Çağrı T. A., Tüysüz, F., & Kahraman, C. (2013). A fuzzy multi-criteria decision analysis approach for retail location selection. *International Journal of Information Technology, & Decision Making, 12(4)*, 729–755.

Dehghani, A., & Soltani, A. (2023). Site selection of car parking with the gıs-based fuzzy multi-criteria decision making. *International Journal of Information Technology and Decision Making, 23(2)*, 715-740.

Dell'Ovo, M., Capolongo, S., & Oppio, A. (2018, July). Combining spatial analysis with MCDA for the siting of healthcare facilities. *Land Use Policy*, *76*, 634–644.

Dehshiri, S. J. H., Mostafaeipour, A., Le, T., & Sabagh, A. R. (2024). Evaluation of sustainable hydrogen production technologies on an industrial scale using comparative analysis of decision-making methods. *Environmental Science and Pollution Research International*, 1-17.

Dosal, E., Viguri, J. R., & Andrés, A. (2013). Multi-criteria decision-making methods for the optimal location of construction and demolition waste (C&DW) recycling facilities. In *Handbook of recycled concrete and demolition waste* (pp. 76-107). Woodhead Publishing.

Edwards, W. (1971). Social utilities. *The Engineering Economist Summer Symposium Series 6*. 119–129.

Feng, Z., Li, G., Wang, W., Zhang, L., Xiang, W., He, X., Zhang, M., & Wei, N. (2023). Emergency logistics centers site selection by multi-criteria decision-making and GIS. *International Journal of Disaster Risk Reduction, 96*, 103921.

Gabus, A., & Fontela, E. (1972). *World problems, an invitation to further thought within the framework of DEMATEL*. Geneva, Switzerland: Battelle Geneva Research Center.

Ghattas, D.A., & Al-Abdallah, G.M. (2020). Factors affecting customers selection of community pharmacies: The mediating effect of branded pharmacies and the moderating effect of demographics. *Management Science Letters, 10*, 1813-1826

Greenhut, M. L., (1956). *Plant Location in Theory and in Practise*. Chapel Hill, North Carolina: University of North Carolina Press.

Hashemkhani Zolfani, S., Dehnavieh, R., Poursheikhali, A., Prentkovskis, O., & Khazaelpour, P. (2019). Foresight based on madm-based scenarios' approach: a case about comprehensive sustainable health financing models. *Symmetry*, *12(1),* 61-88.

Hwang, C. L., & Yoon K. (1981). *Multiple attribute decision making: methods and applications—a state-of-the-art survey (lecture notes in economics and mathematical systems)*. New York: Springer.

Isard, W., (1956). *Location and Space Economy*. Cambridge: Technology Press, MIT.

Islam, M. R., Aziz, M. T., Alauddin, M., Kader, Z., & Islam, M. R. (2024). Site suitability assessment for solar power plants in Bangladesh: A GIS-based analytical hierarchy process (AHP) and multi-criteria decision analysis (MCDA) approach. *Renewable Energy, 220*, 119595.

Jin, H., Zhang, M., & Yuan, Y. (2018). Analytic network process-based multi-criteria decision approach and sensitivity analysis for temporary facility layout planning in construction projects. *Applied Sciences, 8(12)*, 2434.

Keršulienė, V., Zavadskas, E. K., & Turskis, Z. (2010). Selection of rational dispute resolution method by applying new step-wise weight assessment ratio analysis (SWARA). *Journal of Business Economics and Management, 11(2)*, 243–258.

Köse, Y., Ayyıldız, E., & Çevikcan, E. (2024). Evaluation of disassembly line layouts using an integrated fermatean fuzzy decision-making methodology: An application for refrigerator disassembly line. *Computers & Industrial Engineering*, *190*, 110090.

Mardani, A., Jusoh, A., MD Nor, K., Khalifah, Z., Zakwan, N., & Valipour, A. (2015). Multiple criteria decision-making techniques and their applications – a review of the literature from 2000 to 2014. *Economic Research-Ekonomska Istraživanja, 28(1)*, 516–571.

Moradi, M., & Bidkhori, M. (2009). Single facility location problem. In R. Z. Farahani, & M. Hekmatfar (Eds.), *Facility location: Concepts, models, algorithms and case studies. Contributions to management science*. Heidelberg: Physica-Verlag.

Mota, I., & Brandão, A. (2013). The determinants of location choice: Single plants versus multi-plants. *Papers in Regional Science, 92(1),* 31–50.

Mousavi, S. M., Tavakkoli-Moghaddam, R., Heydar, M., & Ebrahimnejad, S. (2012). Multi-criteria decision making for plant location selection: an ıntegrated Delphi–AHP–PROMETHEE methodology. *Arabian Journal for Science and Engineering, 38(5)*, 1255–1268.

Opricović, S. (1990). Programski paket VIKOR za visekriterijumsko kompromisno rangiranje, *17th International symposium on operational research.* Belgrade, Serbia: SYM-OP-IS.

Pednekar P, & Peterson A (2018). Mapping pharmacy deserts and determining accessibility to community pharmacy services for elderly enrolled in a State Pharmaceutical Assistance Program. *PLoS ONE*, *13(6),* e0198173.

Petrović, G., Mihajlović, J., Marković, D., Zolfani, S. H., & Madić, M. (2023). Comparison of Aggregation Operators in the Group Decision-Making Process: A Real Case Study of Location Selection Problem. *Sustainability, 15(10)*, 8229.

Raad, N. G., & Rajendran, S. (2024). A Hybrid Robust SBM-DEA, Multiple Regression, and MCDM-GIS Model for Airport Site Selection: Case Study of Sistan and Baluchestan Province, Iran. *Transportation Engineering, 16*, 100235.

Rai, M., Goyal R. (2017). Pharmacoeconomics in Healthcare Vohora, D., & Singh, G. (Eds.). *Pharmaceutical medicine and translational clinical research* (pp.465-472). Massachusetts: Academic Press.

Saaty, T. L. (1980). *The analytic hierarchy process*. New York: McGraw-Hill.

Saaty, T. L. (1996). *Decision making with dependence and feedback: The analytic network process*. Pittsburgh: RWS Publications.

Sarkar, B. (2011). Fuzzy decision making and its applications in cotton fibre grading. In A. Majumdar (Eds.), *Soft Computing in textile engineering* (pp. 353-383). Sawston: Woodhead Publishing.

Serna, S., Gerres, T., & Cossent, R. (2023). Multi-criteria decision-making for renewable hydrogen production site selection: a systematic literature review. *Current Sustainable/ Renewable Energy Reports, 10(3)*, 119–129.

Shao, M., Han, Z., Sun, J., Xiao, C., Zhang, S., & Zhao, Y. (2020). A review of multi-criteria decision making applications for renewable energy site selection. *Renewable Energy, 157*, 377–403.

Sharma, H., Sohani, N., & Yadav, A. (2023). A fuzzy SWARA-WASPAS based approach for determining the role of lean practices in enabling the supply chain agility. *International Journal of System Assurance Engineering and Management, 14(S1)*, 492–511.

Simic, V., Karagoz, S., Deveci, M., & Aydin, N. (2021). Picture fuzzy extension of the CODAS method for multi-criteria vehicle shredding facility location. *Expert Systems With Applications, 175*, 114644.

Singh, R., &Modgil, S. (2020). Supplier selection using swara and waspas – a case study of Indian cement industry. *Measuring Business Excellence*, *24(2),* 243-265.

Thakkar, J.J. (2021a). Stepwise weight assessment ratio analysis (SWARA). In: *Multi-Criteria Decision Making. Studies in Systems, Decision and Control* (pp. 281-289). Singapore: Springer.

Thakkar, J.J. (2021b). Weighted aggregated sum product assessment (WASPAS). In: *Multi-Criteria Decision Making. Studies in Systems, Decision and Control* (pp. 253-279). Singapore: Springer.

Thomas, D., Hiligsmann, M., John, D., Al Ahdab, O. G., & Li, H. (2019). Pharmacoeconomic analyses and modeling. In T. Dixon (Ed.). *Clinical pharmacy education, practice and research* (pp. 261-275). Amsterdam: Elsevier.

Vahidnia, M., Alesheikh, A., & Alimohammadi, A. (2009). Hospital site selection using fuzzy AHP and its derivatives. *Journal of Environmental Management*, *90(10),* 3048-3056.

Vinchurkar, S. H., & Samtani, B. K. (2019). Performance evaluation of the hydropower plants using various multi-criteria decision-making techniques. *International Journal of Engineering and Advanced Technology*, *8*(6), 2131-2138.

Warfield, J. N. (1974). *Structuring complex systems*. Ohio: Battelle Memorial Institute.

Weber, A., (1909). *Ueber den Standort der Industrien. 1. Reine Theorie des Standorts*. Germany: Mohr.

Wisseh, C., Hildreth, K., Marshall, J., Tanner, A., Bazargan, M., & Robinson, P. (2020). Social determinants of pharmacy deserts in Los Angeles County. *Journal of Racial and Ethnic Health Disparities*, *8(6),* 1424-1434.

Xu, W., Liu, L., Zhang, Q., & Liu, P. (2018) Location decision-making of equipment manufacturing enterprise under dual-channel purchase and sale mode. *Complexity, 2,* 1-16.

Wan, S. P., Wu, H., & Dong, J. Y. (2024). An integrated method for complex heterogeneous multi-attribute group decision-making and application to photovoltaic power station site selection. *Expert Systems With Applications, 242*, 122456.

Yüceşahin, M. M., & Tüysüz, S. (2011). Ankara kentinde sosyo-mekânsal farklılaşmanın örüntüleri: ampirik bir analiz. *Coğrafi Bilimler Dergisi, 9(2)*, 159-188.

Zhang, Z., Wang, Z., Li, G., Zhao, M., & Li, W. (2024). The suitability assessment on site selection for bottom-seeding scallop culture based on analytic hierarchy process. *Journal of Oceanology and Limnology, 42,* 647-663.

Zavadskas, E. K., Kaklauskas, A., & Sarka, V. (1994). The new method of multicriteria complex proportional assessment of projects. *Technological and Economic Development of Economy, 1(3),* 131–139.

Zavadskas, E. K., & Turskis, Z. (2010). A new additive ratio assessment (ARAS) method in multi-criteria decision-making. *Technological and Economic Development of Economy, 16(2)*, 159–172.

Zavadskas, E. K., Turskis, Z., Antucheviciene, J., & Zakarevicius, A. (2012). Optimization of weighted aggregated sum product assessment. *Elektronika Ir Elektrotechnika, 122(6)*, 3-6.

Zavadskas, E. K., Đalić, I., & Stević, E. (2021). Application of novel DEA-SWARA-WASPAS model for efficiency assessment of agricultural products. *Journal of Smart Environments and Green Computing*, *1*, 32-46.