European Journal of Engineering and Applied Sciences

ISSN: 2651-3412 (Print) & 2667-8454 (Online)
Journal homepage: http://dergipark.gov.tr/EJEAS
Published by Çorlu Faculty of Engineering, Tekirdağ Namık Kemal University

European J. Eng. App. Sci. 8(2), 63-67, 2025

Research Article

Strategies for Enhancing Public Transportation Efficiency in Aksaray

Tayfun ÇELİK[1] Hümeyra BOLAKAR TOSUN[2, *]

[1] Tübitak İdari Hizmetler, TÜBİTAK, Ankara, Türkiye
[2] İnşaat Mühendisliği Bölümü, Mühendislik Fakültesi, Aksaray Üniversitesi, Aksaray, Türkiye
[1]tayfun.celik@csb.gov.tr, [2]bolakarhumeyra@gmail.com

Received: 08.12.2025 Accepted: 17.12.2025 DOI: 10.55581/ejeas.1838649

Abstract: This study conducts a comprehensive assessment of the public transportation system in the city of Aksaray and proposes improvement strategies to enhance system efficiency and address urban mobility challenges. Increasing population, expanding settlement patterns, and peak-hour demand pressure have led to the inadequacy of the existing transportation infrastructure in meeting passenger needs. Insufficient vehicle capacity on certain routes, outdated infrastructure, traffic congestion, and operational inefficiencies negatively affect the overall performance of the public transport network. The findings highlight the necessity of optimizing route capacity, strengthening traffic management systems, integrating environmentally friendly technologies such as electric buses, and improving passenger comfort and safety. Additionally, the study emphasizes the importance of modernizing the urban transport infrastructure and implementing smart mobility solutions to ensure a sustainable public transportation system. The results provide policy recommendations aimed at increasing operational efficiency, reducing environmental impacts, and enhancing user satisfaction.

Keywords: *Public Transportation, Transportation Infrastructure, Bus Routes, Traffic Management, Sustainable Transportation*

Aksaray'da Toplu Taşıma Verimliliğini Artırmaya Yönelik Stratejiler

Öz. Bu çalışma, Aksaray ilindeki mevcut toplu taşıma sistemini kapsamlı biçimde analiz ederek sistemin etkinliğini artırmaya yönelik iyileştirme stratejileri geliştirmeyi amaçlamaktadır. Kentte artan nüfus, düzensiz yapılaşma ve yoğun saatlerde belirginleşen talep baskısı, mevcut ulaşım altyapısının kapasitesini aşmakta ve hizmet kalitesini düşürmektedir. Özellikle bazı hatlarda araç kapasitesinin yetersiz kalması, altyapının eski olması, düzensiz trafik akışı ve yol ağındaki darboğazlar toplu taşıma performansını olumsuz etkilemektedir. Bu bağlamda çalışma; hat kapasitesinin optimize edilmesi, trafik yönetim sistemlerinin güçlendirilmesi, çevreci ulaşım teknolojilerinin (elektrikli otobüsler vb.) yaygınlaştırılması ve yolcu konforu ile güvenliğini artırmaya yönelik uygulamaların hayata geçirilmesi gerektiğini ortaya koymaktadır. Ayrıca sürdürülebilir bir toplu taşıma yapısının oluşturulması için akıllı ulaşım sistemlerinin geliştirilmesi ve kentsel altyapının modernize edilmesi önerilmektedir. Elde edilen bulgular, toplu taşıma verimliliğini artıracak, çevresel etkileri azaltacak ve yolcu memnuniyetini yükseltecek politika önerileri sunmaktadır.

Anahtar kelimeler: *Toplu Taşıma, Ulaşım Altyapısı, Otobüs Hatları, Trafik Yönetimi, Sürdürülebilir Ulaşım.*

1. Introduction

Urban transportation systems are among the fundamental components that directly shape the economic, social, and environmental structure of cities. In modern urban environments, transportation is not only essential for sustaining daily activities but also plays a critical role in ensuring sustainability, economic development, and social equity. The effective planning and management of transportation infrastructure depend on various factors,

∗ Corresponding author
E-mail address: bolakarhumeyra@gmail.com (H. BOLAKAR TOSUN)

including city size, population density, land-use patterns, and the diversity of economic activities. Consequently, identifying urban transportation problems and developing context-specific solution strategies constitute a key responsibility of urban governance.

In Türkiye, rapid population growth, urbanization, and increasing industrial activities have significantly intensified transportation-related challenges. Existing urban transportation networks and public transport systems strongly influence the spatial development and livability of cities (Koçakaya & Engin, 2020). Medium-sized cities, such as Aksaray, are particularly vulnerable to these challenges due to limited infrastructure capacity, dispersed urban growth, and rising travel demand. These conditions often result in traffic congestion, increased travel times, environmental pollution, and reduced user satisfaction (Banister, 2008; Vuchic, 2007).

Urban transportation systems directly affect a city's operational efficiency, economic productivity, environmental performance, and social inclusiveness. In this context, developing an effective and sustainable public transportation system requires an integrated approach that combines demand-oriented planning, operational efficiency, environmental sensitivity, and user-centered service design. However, despite the growing importance of these issues, empirical and city-specific studies focusing on medium-sized Anatolian cities remain limited in the literature.

This study aims to address this gap by systematically identifying urban transportation problems in the city of Aksaray and proposing practical and sustainable solution strategies. The research analyzes the current transportation system by examining infrastructure conditions, public transportation usage patterns, system efficiency, and passenger satisfaction levels. To achieve this objective, survey data and field observations were employed to capture user perceptions and operational challenges within the existing transportation network.

The findings of this study are expected to contribute to the improvement of public transportation efficiency, the identification of infrastructure deficiencies, and the development of sustainable urban mobility strategies tailored to Aksaray's local conditions. By providing data-driven insights, the study offers valuable guidance for urban planners, municipal authorities, and public transportation operators. Considering that transportation is not only a functional necessity but also a key driver of economic growth and quality of life, this research aims to support more resilient, accessible, and sustainable urban transportation systems.

2. Material and Method

Aksaray is located in the Central Anatolia Region of Türkiye and holds a strategically important position due to its location at the intersection of major highway corridors connecting Ankara, Konya, Nevşehir, and Niğde. This geographical advantage makes the city a regional hub for logistics, trade, and intercity mobility. The predominantly flat topography of Aksaray facilitates the development and expansion of transportation infrastructure; however, rapid population growth and increasing industrial activity have intensified pressure on the existing urban transportation system (Aldanmaz, 2019; Doğaroğlu, 2019).

Climatic conditions constitute another critical factor influencing transportation performance in the city. Aksaray experiences a continental climate characterized by hot and dry summers and cold, snowy winters. During winter months, snow and frost adversely affect road safety and operational continuity, while in summer, high temperatures—reaching up to 40 °C—accelerate pavement deterioration and reduce passenger comfort in public transport vehicles (Hakverdi, 2021; Kocalar, 2023). These conditions highlight the necessity of climate-resilient transportation planning and infrastructure design (Başkaya et al., 2020).

Given these geographical and climatic characteristics, improving public transportation efficiency and reducing dependence on private vehicles are essential for sustainable urban mobility. Enhancing public transport capacity, developing alternative routes, and supporting environmentally friendly modes such as cycling, walking, and electric vehicles are particularly important for reducing congestion and emissions (Yavuz, 2024).

2.1. Data Collection and Survey Design

To evaluate the current status of Aksaray's urban transportation system, a structured questionnaire survey was conducted within the scope of the Aksaray Province Traffic Emergency Action Plan. The survey aimed to analyze travel behavior, user satisfaction, and perceived deficiencies in the existing transportation infrastructure. The questionnaire included sections on demographic characteristics, preferred transportation modes, experienced problems, and opinions regarding public transportation services.

A total of 161 participants took part in the survey. The demographic distribution indicates that 60.2% of respondents were male and 39.8% were female (Table 1, Figure 1). In terms of marital status, 61.5% of participants were single and 38.5% were married (Table 2, Figure 2). These demographic variables were considered relevant, as travel behavior and public transport preferences may vary according to personal and household characteristics.

Table 1. Gender Distribution of Survey Participants

	Frequency	Percent	Cumulativ percent
Male	97	60,2	60,2
Female	64	39,8	100,0
Total	161	100,0	

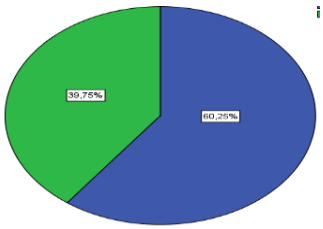

Figure 1. *Gender Distribution of Survey Participants*

Table 2 reflects the marital status of the survey participants. While 61.5% of the respondents are married, 38.5% are single.

Table 2. Marital Status Distribution of Survey Participants

	Frequency	Percent	Cumulative Percent
Single	99	61,5	61,5
Married	62	38,5	100,0
Total	161	100,0	

These data are important for understanding the demographic characteristics of the survey participants and for interpreting the results, as marital status may influence individuals' preferences and experiences.

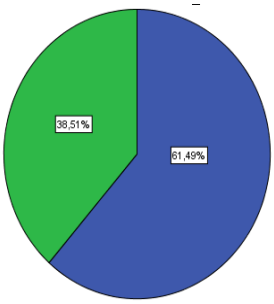

Figure 2. *Marital Status Distribution of Survey Participants*

The age distribution of respondents shows that the majority belonged to the 28–37 age group (36.0%), followed by 18–27 (23.0%) and 38–47 (21.1%) age groups (Table 3, Figure 3). This indicates that the survey primarily reflects the perspectives of economically active and socially mobile population segments, who are also the most frequent users of urban transportation systems.

Table 3. Age Distribution of Survey Participants

	Frequency	Percent	Cumulative Percent
18-27	37	23,0	23,0
28-37	58	36,0	59,0
38-47	34	21,1	80,1
48-57	24	14,9	95,0
58 +	8	5,0	100,0
Total	161	100,0	

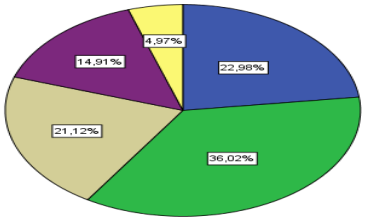

Figure 3. *Age Distribution of Survey Participants*

Figure 3 shows that the age distribution of the survey participants consists mainly of young and middle-aged adults.

2.2. Contribution of the Study

Unlike previous studies that primarily focus on general urban transportation characteristics, this research integrates local geographical and climatic conditions with user-based survey data to identify practical improvement strategies for public transportation in Aksaray. By combining spatial characteristics with user perceptions, the study provides location-specific insights that can support decision-makers in developing more resilient, efficient, and sustainable urban transport policies.

3. DISCUSSION AND CONCLUSION

Urban transportation systems, especially in large and rapidly growing cities, are a crucial element that affects the daily lives of citizens. These systems are closely linked to economic, social, and environmental factors and directly influence the overall quality of life in cities. The efficiency of public transportation, the effectiveness of transportation infrastructure, and passenger satisfaction are key indicators determining the success of such systems. This study aims to examine the existing public transportation system in the city, identify the aspects of current routes that need improvement, and propose recommendations to enhance the system's sustainability. The analysis conducted based on the available data shows that the transportation infrastructure in many parts of the city does not operate efficiently, and public transportation services are at times insufficient. First, it can be stated that the urban transportation infrastructure has not developed in parallel with the growing population and changing transportation needs. During peak hours, particularly during morning and evening commutes, the capacity of public transportation vehicles is generally insufficient. Bus lines often cannot accommodate passengers due to overcrowding, resulting in longer waiting times. This situation leads to passenger dissatisfaction and negatively affects the use of public transportation. Some routes in the city, especially those between the city center and densely populated areas, experience high demand. However, the routes and number of vehicles on these lines often fail to meet passenger demand. To address this issue, service frequency should be increased, capacity should be expanded, and vehicles should be modernized.Another major problem is the inadequacy of road infrastructure. Damaged roads, insufficient intersections, and narrow streets negatively impact the speed of public transportation vehicles and increase travel times for passengers. This situation contributes to increased traffic congestion experienced by both public transportation users and private vehicle owners. Particularly, the narrowing of major arteries and the poor condition of road surfaces make it difficult for public transportation vehicles to pass. This adversely affects traffic flow and prevents public transportation vehicles from reaching their destinations efficiently. Modernizing the roads is critical to reducing traffic congestion on major routes, shortening travel times, and improving the efficiency of the public transportation system.Traffic management is another important factor for the efficient functioning of urban transportation. Existing traffic management systems are insufficient, especially during peak

hours. Since traffic lights are not optimized according to passenger demand, public transportation vehicles frequently experience delays. Moreover, the lack of dedicated bus lanes on some streets causes buses to travel in the same lanes as private vehicles, leading to additional time loss. In such situations, creating dedicated lanes for buses, optimizing traffic lights, and implementing smart traffic management systems would improve the efficiency of public transportation.

Environmental sustainability is a critical factor for the future of public transportation systems. Current buses and other public transportation vehicles often operate with outdated technologies, increasing environmental impacts. These vehicles contribute to carbon emissions, air pollution, and noise pollution. To make the city's public transportation system more environmentally friendly, the use of electric and hybrid buses should be expanded. Electric vehicles consume less energy and produce lower carbon emissions. The widespread adoption of such vehicles would improve air quality in the city and support environmentally friendly transportation solutions. Additionally, the efficient operation of public transportation vehicles contributes to economic savings by reducing energy consumption.Ensuring comfort and safety is essential to increase public interest in public transportation. Many of the current vehicles are old and require improvements to enhance passenger comfort. Enhancements such as better seat layouts, cleanliness, safety measures, and improved information systems can increase passenger satisfaction. Additionally, making vehicles and stops more accessible for individuals with disabilities is necessary to ensure inclusivity. Such arrangements would make public transportation services more accessible and appealing to a wider range of users.

Another important step for improving the future efficiency of the public transportation system is strengthening the integration of transportation routes. Integrating public transportation lines with other transportation modes—such as metro, tram, bicycle paths, and pedestrian walkways—enhances the efficiency of the transportation network. Passengers can switch easily between different modes of transport, enabling a faster and more efficient travel experience. Such integrations provide more options to meet passengers' transportation needs and encourage the use of public transportation.

The city's public transportation system requires improvements in terms of efficiency and sustainability. Existing lines, road infrastructure, and traffic management systems are at times insufficient to meet passenger needs. To address these issues, bus line capacities must be increased, roads modernized, traffic management improved, environmentally friendly vehicles adopted, and passenger satisfaction enhanced. These improvements will not only increase the effectiveness of the public transportation system but also help solve urban transportation problems and support environmental sustainability.Improving the public transportation system not only addresses current challenges but also increases the overall efficiency of urban mobility and contributes to economic development. As part of the improvement process, more integrated management of urban transportation provides economic advantages. Faster and more efficient transportation allows the workforce to move more effectively and strengthens connections between workplaces and commercial centers. Additionally, making public transportation more accessible encourages people to choose public transportation over private vehicles, thereby reducing traffic congestion and preventing time loss. This makes the city more livable while reducing traffic accidents and related economic losses.

However, to ensure the sustainability of the public transportation system, strategic future-oriented transportation plans must be developed. These plans should not only meet current needs but also consider future population growth and increasing transportation demand. City growth will lead to higher public transportation demand; therefore, the capacity of public transportation infrastructure must be planned to meet future needs. Long-term strategies should include innovative solutions to minimize environmental impacts, such as using greener and more energy-efficient vehicles to improve air quality. For improvement suggestions to be successful, the needs of communities and passengers must be considered in the design of public transportation systems. Passenger feedback is an important tool in this process, as it helps identify deficiencies and problems. Real-time evaluation of passenger dissatisfaction supports the continuous improvement of services. Public transportation should remain flexible and innovative, adapting to changing conditions. Routes, service frequency, and the number of vehicles should be planned based on passenger demand, ensuring efficient service delivery through ongoing improvements.

Additionally, effective operation of the public transportation system requires coordination between local authorities and relevant institutions. Developing transportation infrastructure should not be limited to transportation planning alone; it must be integrated with urban planning and environmental policies. For example, integrating green areas, bicycle lanes, pedestrian paths, and public transportation stops would make the city more sustainable and accessible. This not only improves transportation efficiency but also reduces environmental impacts. Ensuring the financial sustainability of public transportation systems is also crucial. Funding for such improvements and investments can be obtained not only from public transportation fares but also from local governments, government incentives, private sector partnerships, and funds allocated for sustainable transportation projects. Improving the public transportation infrastructure enhances quality of life in the city, supports economic growth, and ensures environmental sustainability. These investments yield high long-term returns and prepare the city's transportation infrastructure for future needs.

The efficiency of the city's public transportation system is of great importance in addressing infrastructure deficiencies, ensuring environmental sustainability, and maximizing passenger satisfaction. Identifying the routes that require improvement and implementing necessary adjustments play a significant role in solving transportation problems and enhancing the efficiency of the public transportation system. This process will improve the quality of life in the city, support economic development, and reduce environmental impacts.

Urban public transportation must be comprehensively improved to increase efficiency, ensure environmental

sustainability, and maximize passenger satisfaction. The improvement recommendations presented in this study will help make urban transportation infrastructure more efficient, while contributing to a more sustainable, environmentally friendly, and user-friendly public transportation system. Future investments will increase system capacity, reduce traffic congestion, and make the city more livable. These improvements will enhance the quality of urban life and support the achievement of economic and environmental goals.

Author Contribution

Investigation, writing, review, Tayfun Çelik; Writing-original draft Hümeyra Bolakar Tosun

Declaration of Competing Interest

The authors declared no conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

[1] Kocakaya, K., & Engin, T. (2020). 22@ Barcelona Projesi Analizi; Bandırma Ölçeğinde Uygulanabilirliği. Akıllı Ulaşım Sistemleri ve Uygulamaları Dergisi.

[2] Banister, D. (2008). The sustainable mobility paradigm. Transport Policy, 15(2), 73–80.3(1), 71-84. https://dergipark.org.tr/en/pub/jitsa/issue/53369/717087

[3] Vuchic, V. (2007). Urban Transit Systems and Technology. Wiley.

[4] Aldanmaz, E. (2019). Akıllı kentler kapsamında Türkiye için akıllı ulaşım sistemleri ihtiyaç analizi [Master's Thesis, Fen Bilimleri Enstitüsü]. https://acikbilim.yok.gov.tr/handle/20.500.12812/674444

[5] Doğaroğlu, B. (2019). Akıllı otopark sistemi uygulamaları üzerine bir inceleme [Master's Thesis, Dokuz Eylul Universitesi (Turkey)]

[6] Kocalar, A. C. (2023). Akıllı Şehir Lojistiği Kapsamında Akıllı Ulaşım Sistemleri (AUS) için Sistem Analizi. Journal of Transportation and Logistics, 8(1), 73-82. https://dergipark.org.tr/en/pub/jtl/issue/79774/1226076

[7] Başkaya, O., Ağaçsapan, B., & Çabuk, A. (2020). Akıllı Şehirler Kapsamında Yapay Zekâ Teknikleri Kullanarak Etkin Ulaşım Planlarının Oluşturulması Üzerine Bir Model Önerisi. Gsı Journals Serie C: Advancements İn Information Sciences And Technologies, 3(1), 1-21. https://dergipark.org.tr/en/download/article-file/979967

[8] Yiğit, Y., & Karabatak, M. (2023). Akıllı Şehirler ve Trafik Güvenliği için Sürüş Kontrolü Uygulaması. Fırat Üniversitesi Mühendislik Bilimleri Dergisi, 35(2), 761-770. https://dergipark.org.tr/en/pub/fumbd/issue/76699/1254249

[9] Hakverdi, F. (2021). Akıllı Şehirlerde Engelsiz Akıllı Ulaşım [Master's Thesis, Necmettin Erbakan University (Turkey)]. https://search.proquest.com/openview/0ffe7c9e0f1b8f4a0134c8e1d28b1003/1?pq-origsite=gscholar&cbl=2026366&diss=y

[10] Yavuz, H. R. (2024). Akıllı Şehirlerde Ulaşım Özelinde İstanbul Örneği. Premium e-Journal of Social Sciences (PEJOSS), 8(38), 91-96. https://pejoss.com/index.php/pub/article/view/435

[11] Erkol, O. (2008). Avrupa Birliği ulaştırma politikalarının Türkiyedeki raylı sistemlere etkileri [Master's Thesis, Fen Bilimleri Enstitüsü].