# Cycling the Bo'rijar Route: infrastructure innovation for Tashkent's sustainable transit

**J.I. Sodikov[1][a], K.N. Musulmanov[1][b], D.A. Adizov[1][c]**

[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract:
This research paper presents an in-depth analysis of the development and implementation of cycling infrastructure in Tashkent, aimed at promoting sustainable urban mobility. By integrating environmental features and urban planning best practices, the study outlines a framework for evaluating and enhancing cycling opportunities within the city. The research highlights the strategic planning of 250 km of bicycle lanes by 2025, the establishment of a bike-sharing system, and the provision of secure bicycle parking facilities as key initiatives undertaken by local authorities. It discusses the importance of integrating these cycling lanes with the city's arterial routes, particularly alongside the Bo'rijar Canal, to improve network functionality and accessibility. The paper also emphasizes the significance of color-coding in delineating cycling lanes from pedestrian areas to ensure safety and ease of navigation. Through empirical research and visual analysis, the study demonstrates the potential of well-planned cycling infrastructure in elevating urban livability and supporting environmental sustainability. The findings aim to inform future urban planning strategies, setting a precedent for developing cycling networks in other growing cities.

Keywords:
Urban mobility, cycling infrastructure, sustainable transportation, urban planning, bicycle lanes, bike-sharing system, Tashkent, active mobility, environmental sustainability, urban development

## 1. Introduction

In contemporary urban and transport planning, cycling has emerged as a pivotal strategy to address a myriad of urban challenges [1].

Unlike car-dependent infrastructure, which significantly contributes to urban severance and spatial constraints, cycling infrastructure demands substantially less space and mitigates these issues. The economic advantages of cycling are manifold; it not only reduces the cost associated with infrastructure development compared to motorized transportation modes but also lowers healthcare expenditures, boosts work productivity, and provides an accessible transportation option for a broad spectrum of the population [2]. Nevertheless, the development, construction, and maintenance of bicycle facilities represent complex and financially intensive endeavors. The success of these facilities critically depends on the collection and analysis of reliable data to ensure they meet the needs of potential users [10].

Bicycles offer an efficient solution for short urban trips up to 5 kilometers or those with a duration of approximately 20 minutes, outpacing walking and other motorized transport options in terms of speed and convenience [3]. For distances exceeding this range, bicycles can effectively complement other transport modes, such as public transit, facilitating a more integrated and sustainable urban mobility framework. Recognizing the extensive benefits of cycling, numerous countries have initiated a wide array of measures to encourage regular cycling, reflecting a growing commitment to sustainable transportation [2]. Among these urban areas, Tashkent distinguishes itself with a notable increase in daily bicycle usage, showcasing the city's progress towards embracing cycling as a core component of its transportation ecosystem.

This introduction underscores the importance of cycling within the broader agenda of urban sustainability and mobility. By highlighting the specific case of Tashkent and referencing global efforts to enhance cycling infrastructure and adoption, the paper sets the groundwork for an in-depth exploration of how cycling can be integrated into urban transport systems to achieve economic, environmental, and social benefits. Through this lens, the study aims to contribute valuable insights into the strategies and challenges of fostering a bicycle-friendly urban environment, positioning cycling not only as a mode of transport but as a catalyst for urban transformation.

The global push towards cycling-friendly urban environments involves a multifaceted approach, incorporating policy formulation, infrastructure development, and public engagement. Key to this initiative is the design and implementation of dedicated cycling lanes, secure bike parking facilities, and bike-sharing programs. These measures aim to not only ensure the safety and convenience of cyclists but also to make cycling an attractive alternative to motorized transport. In cities where cycling has been successfully integrated into the urban fabric, such as Amsterdam and Copenhagen, comprehensive cycling networks and supportive policies have significantly increased cycling rates, demonstrating the potential for replication in other urban contexts.

However, the path to becoming a bicycle-friendly city is fraught with challenges. One of the primary obstacles is the allocation of urban space, where cycling infrastructure often competes with motorized transportation and pedestrian areas. Achieving a balanced urban mobility mix requires careful planning and, occasionally, the reallocation of road space from cars to bicycles—a move that can provoke resistance from motorists and businesses accustomed to car-centric urban designs. Additionally, the effectiveness of

[a] https://orcid.org/0000-0002-4005-9766
[b] https://orcid.org/0000-0001-8906-9909
[c] https://orcid.org/0009-0008-2988-4061

**ENGINEER**

cycling infrastructure is contingent upon its integration with other modes of transport, necessitating seamless connections between bike lanes, public transit, and pedestrian pathways to support multi-modal transport options.

The role of technology and data in enhancing cycling infrastructure cannot be understated. Smart mobility solutions, including GPS-enabled bike-sharing schemes and apps that provide real-time information on bike availability, cycling routes, and traffic conditions, are vital in encouraging cycling. Moreover, the collection and analysis of cycling data contribute to informed decision-making, allowing urban planners to identify high-demand areas for bike lanes, optimize bike-sharing station locations, and monitor the impact of cycling on urban mobility and environmental sustainability.

The transition towards more bicycle-friendly cities also hinges on community involvement and behavioral change. Public awareness campaigns, cycling training programs, and events can play a crucial role in shifting perceptions about cycling, addressing safety concerns, and fostering a culture of cycling. Encouragingly, the environmental and health benefits of cycling—reduced carbon emissions, improved air quality, and enhanced physical fitness—are powerful motivators for individuals and policymakers alike to support and invest in cycling infrastructure.

Looking ahead, the integration of cycling into urban transport planning presents a promising avenue for achieving sustainable urban development goals. It offers a pathway to reduce traffic congestion, lower pollution levels, and create more livable, health-oriented urban spaces. As cities like Tashkent continue to evolve and adapt to the needs of their residents, the lessons learned and successes achieved in promoting cycling can serve as valuable blueprints for others seeking to reimagine urban mobility for the better.

## 2. Materials and method

Our research methodology was deployed in the context of Uzbekistan's urban cycling infrastructure, with a particular focus on the capital, Tashkent. In 2022, a notable deficiency in dedicated bicycle lanes—totaling a shortfall of 342 km, or 3.5% of the needed infrastructure—was identified as a contributing factor to the significant number of cycling accidents, which accounted for 1136 incidents, or 11.5% of all reported cases [6]. This data underscores the critical need for a strategic expansion of cycling infrastructure to enhance cyclist safety and promote urban cycling as a sustainable mode of transport.

The focal point of our study was the bicycle lane adjacent to the Bo'zsuv canal, a historically and geographically significant waterway in Tashkent. Originating from the Chirchiq River, the Bo'zsuv canal extends from the north-eastern to the south-western parts of the city, tracing the ancient terraces on the right bank of the Chirchiq River. This canal, with its deep historical roots, forms a vital part of the city's heritage and urban landscape.

In recent years, the local authorities have recognized the potential of integrating recreational infrastructure, such as bicycle routes, with Tashkent's natural and historical features to boost tourism and enhance the city's livability. The development of bicycle lanes along the Bo'zsuv canal is part of a broader initiative to leverage Tashkent's unique environmental assets to attract tourists and promote active transportation [7]. However, our observations and analyses revealed that the renovation efforts often neglect critical aspects related to the surrounding landscape. The oversight of landscape considerations in the development of bicycle lanes not only diminishes the potential aesthetic and recreational value of these routes but may also pose safety and accessibility challenges for cyclists.

To address these issues, our research employed a comprehensive data collection methodology that included field observations, cyclist interviews, and accident data analysis. By examining the interplay between the physical infrastructure of bicycle lanes and the surrounding environmental features, we aimed to identify both the strengths and shortcomings of the current approach to cycling infrastructure development in Tashkent. Our study seeks to offer insights into how urban planning and design strategies can better accommodate the needs of cyclists, enhance safety, and capitalize on the city's cultural and natural heritage to create a more appealing and sustainable urban environment.

## 3. Conclusion

This research aims to delineate a comprehensive methodology for assessing cycling opportunities within Tashkent and for the strategic planning of bicycle infrastructure. Addressing a notable gap in existing literature on bicycle lane planning, our study incorporates an analysis of environmental attributes—such as elevation profiles, street hierarchies, and the geometry of street networks—utilizing a combination of Quantitative Urbanism Strategies (QUIS) operations and thorough visual inspections. This approach enables us to provide urban planners and decision-makers with nuanced insights into various strategies for fostering cycling in developing urban areas. Through empirical investigation, we have developed preliminary guidelines tailored to meet Tashkent's unique challenges and opportunities, thereby aiding in the advancement of cycling, active mobility, and the decarbonization of the transportation sector, while also addressing sedentary lifestyles.

Our methodology underscores the significance of not only the physical and objective characteristics of cycling infrastructure but also its inherent appeal. The allure of the bicycle network—considered a pivotal factor in encouraging cycling adoption—is systematically evaluated [4]. We analyze the context of cycling paths with respect to variables such as the local road user demographic [9].

In Tashkent, the existence of 12 streets featuring 100 kilometers of bicycle lanes earmarked for cyclists serves as the foundation for devising a multifaceted and accessible urban transport system. This system prioritizes pedestrians, seamlessly integrating cycling, public transport, and personal motor transport to enhance overall infrastructure convenience [5].

To augment the utilization and development of bicycle transportation, several initiatives have been implemented, including:

State support and incentivization for bicycle transportation growth;

Strategic urban policy development focusing on the expansion of bicycle infrastructure, with plans to construct an additional 250 km of bicycle lanes and ancillary facilities by 2025;

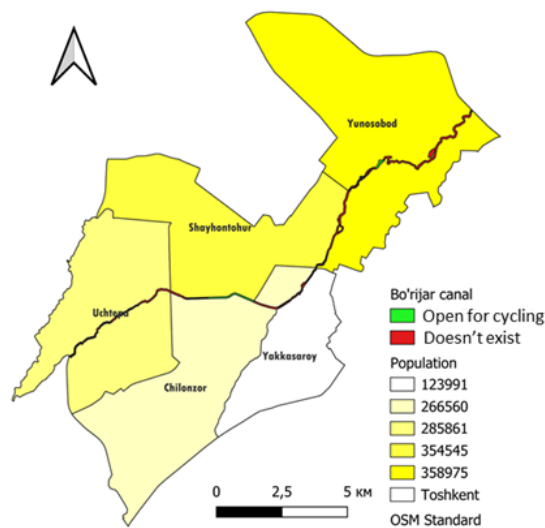The launch of a bike-sharing system to encourage public

bicycle use;



**Fig. 1. Population Density and Cycling Infrastructure Status in Tashkent's Districts**

The provision of ample bicycle parking across various public, commercial, service, and residential areas, as well as transport hubs.

It is important to note that cycling promotion policies and investments predominantly occur at the local level, with impacts and strategies varying significantly across different countries and cities [8]. The execution of this concept and the expected outcomes from the development of bicycle transportation infrastructure are anticipated to be funded through local budgets, contributions from ministries, and governmental agencies [5].

The inclination of the population towards cycling is analyzed in relation to population density, with statistical mapping revealing a higher concentration of the population in the northeastern sector of the study area. Below in Figure 1, the distribution of the population density across the research area is visually depicted, providing a clear understanding of potential cycling engagement patterns.

Fig. 1 shows a thematic map, highlighting the distribution of population density across different districts in a section of Tashkent, with the Bo'rijar canal as a reference point for existing and non-existing cycling infrastructure.

The districts are color-coded according to their population density, with varying shades of yellow indicating different population levels, ranging from 123991 to 359875. The district with the highest population density is marked in the darkest shade, suggesting it might be a focal area for urban cycling planning due to the potential high demand for bicycle infrastructure.

The Bo'rijar canal is marked with two distinct colors: a section of it is marked in red, indicating areas where cycling infrastructure does not exist, while the other section is outlined in green, signifying areas open to cycling. This distinction is critical for urban planners and decision-makers as it identifies where infrastructure is needed to support the population's mobility and where it is already in place.

This map could serve as a visual tool for assessing the current state of cycling infrastructure in relation to population density in Tashkent. It provides a geographical representation of the city's districts that could benefit from the development of cycling lanes, as well as a starting point for discussing the allocation of resources for infrastructure development. The color-coding effectively communicates areas of priority for urban planning to facilitate cycling as a sustainable mode of transport, potentially contributing to the decarbonization of the transportation sector and promoting active mobility among the city's residents.

Fig. 2 provides a detailed view of Tashkent's cycling network along Bo'rijar canal overlaid on the city's layout. It clearly delineates the areas where cycling paths are open for use and sections where such infrastructure does not exist. The cycling network is highlighted in green for areas open to cycling and red where the infrastructure is absent. This color coding helps in quickly identifying and assessing the current state of cycling infrastructure within the city. Tashkent's street grid is visible beneath the cycling network overlay, providing a detailed urban context. The map includes a scale bar indicating a distance of 2.5 and 5 kilometers for spatial orientation.



**Fig. 2 Visual Overview of Tashkent's Cycling Route Along Bo'rijar Canal**

Additionally, there are photographic insets placed around the map, each marked with a circled number corresponding to locations on the map itself. These images provide a visual reference for the condition and ambiance of specific points within the cycling network, offering a qualitative insight into the cycling experience in various parts of the city. These might include views of cycling lanes, integration with public spaces, and the interfacing of cycling paths with other forms of transportation infrastructure.

This map serves as a visual supplement to the research data, offering empirical evidence of the cycling infrastructure's state in Tashkent. It not only assists in pinpointing where improvements can be made to existing paths but also helps urban planners visualize the city's areas that could benefit from the development of new cycling infrastructure. The map, with its photographic evidence, underscores the practical aspects of cycling infrastructure as experienced by users and can be crucial in advocating for more comprehensive urban cycling policies.

The strategic allocation of bicycle lanes along principal arterial routes is essential to creating an efficient and accessible urban cycling network. The Bo'rijar Canal, a prominent feature in Tashkent's cityscape, presents a unique opportunity to serve as a central axis for such infrastructure development. It is proposed that bicycle lanes be planned to flank this arterial waterway, as highlighted in Figure 2, where we can already discern sections of existing lanes. The development of this canal-side cycling route is expected to catalyze the integration of cycling into daily commutes, leisure activities, and tourism. The recommendation to extend and seamlessly connect these nascent bicycle lanes with adjacent streets and residential zones is a crucial step toward fostering a cohesive urban fabric where cycling is not only viable but encouraged. The integration of these lanes with the broader urban matrix will facilitate convenient access for residents and visitors alike, promoting the use of bicycles for a variety of journey types and purposes.

The deliberate color-coding of bicycle lanes, distinct from pedestrian areas, is not merely a functional measure to delineate the cycling route; it also serves to enhance the visual appeal of the lanes. Such visual clarity in the urban landscape simplifies navigation for cyclists, engendering an attractive and user-friendly cycling environment. Moreover, this delineation fosters a safer coexistence between cyclists and other forms of transportation, mitigating potential conflicts and encouraging a harmonious shared use of the city's thoroughfares. The safe and harmonious integration of bicycle lanes with other transportation modes is of paramount importance. It supports the vision of sustainable urban mobility by providing a dedicated space for cyclists, thus ensuring their safety and encouraging the adoption of cycling as a regular mode of transportation. This initiative also aligns with global urban development goals, which advocate for reducing vehicular emissions and promoting healthier lifestyles. In summary, the development of a canal-aligned bicycle lane network in Tashkent as a component of the city's arterial framework is a forward-thinking proposition. It promises to enhance urban connectivity, support environmental sustainability, and improve the overall quality of life for the city's inhabitants.

## 4. Conclusion

The conclusions of this study underscore the pivotal role

a well-orchestrated cycling network plays in advancing sustainable urban mobility. The commitment to construct 250 km of specialized bicycle lanes and ancillary structures by 2025, combined with the establishment of a public bike-sharing system and the installation of secure bike parking across the city, reflects the dedication of Tashkent's authorities to foster cycling accessibility. These initiatives are poised to serve as a cornerstone for urban planning policies aimed at creating more sustainable and active communities.

The accompanying visual representation in Figure 2 not only reinforces the proposed network's strategic plan but also accentuates the importance of integrating the bicycle lanes with existing streets and living spaces to ensure the network's optimal functionality and adoption. This integration is crucial in realizing a cycling infrastructure that supports widespread utilization and enhances the city's overall connectivity.

Distinct color coding of bicycle lanes is more than a mere design choice; it is a safety feature that demarcates cycling zones, guiding cyclists away from vehicular traffic and creating a user-friendly cycling environment. Such visual cues are instrumental in promoting a safer, more navigable, and inviting cycling experience. They are also indicative of the careful consideration given to the user experience, aiming to establish cycling as a viable and preferred option for urban travel.

In conclusion, the findings from this research validate the transformative impact that a thoughtfully designed and fully integrated cycling network can have on a city. When implemented successfully, it can significantly enhance urban life by offering a sustainable alternative to motorized transport, contributing to public health, and reducing environmental impact. These conclusions advocate for the robust potential of cycling infrastructure to not only transform transportation dynamics but also to contribute positively to the urban ecosystem.

## Future work and directions

The findings of this research present a compelling case for the continued development and enhancement of Tashkent's cycling infrastructure. Moving forward, several key areas warrant further exploration to maximize the effectiveness of urban cycling initiatives and to continue promoting sustainable transportation.

1. ***Intermodal Connectivity:*** Future studies should focus on the integration of cycling networks with other modes of public transportation. This would include analyzing optimal locations for bike-sharing stations in proximity to bus, metro, and tram stops to facilitate easy transitions between different transport modes.

2. ***User Behavior Analysis:*** Understanding the cycling habits, preferences, and safety perceptions of Tashkent's residents will be essential. Detailed surveys and data analytics can help tailor the cycling infrastructure to the community's needs and encourage greater adoption rates.

3. ***Impact Assessment:*** Longitudinal studies assessing the impact of new cycling infrastructure on urban traffic patterns, health outcomes, and environmental indicators will be crucial. These studies would provide valuable feedback on the effectiveness of current strategies and inform necessary adjustments.

4. ***Technological Integration***: Exploring the role of smart city technologies, such as real-time tracking systems

for bike availability and maintenance, can significantly enhance the cycling experience. Research into app-based solutions for route planning and user feedback could further streamline cycling in urban settings.

5. ***Policy and Economic Evaluations:*** Future work should also include the economic analyses of cycling infrastructure investments, considering both the direct and indirect benefits. Additionally, policy impact studies can help understand the effectiveness of cycling-related policies and incentives.

6. ***Cultural and Social Dimensions:*** Examining the cultural and social influences on cycling can provide insights into how to shift public attitudes and norms towards sustainable transport options.

***Design Innovations:*** Investigating advancements in cycling lane designs, materials, and layouts to increase safety and usability in all weather conditions is another important direction. This includes the study of innovative urban design solutions that integrate cycling paths with public spaces and green areas.

# References

[1] Gladys Frame, Arturo Ardila-Gomez, Yang Chen, "The kingdom of the bicycle: what Wuhan can learn from Amsterdam," Transportation Research Procedia, Volume 25, 2017, Pages 5040-5058, ISSN 2352-1465, https://doi.org/10.1016/j.trpro.2017.05.203.

[2] Fonseca, F.; Ribeiro, P.; Neiva, C. A Planning Practice Method to Assess the Potential for Cycling and to Design a Bicycle Network in a Starter Cycling City in Portugal. Sustainability 2023, 15, 4534. https://doi.org/10.3390/su15054534

[3] David Pérez-Neira, M Pilar Rodríguez-Fernández, Cristina Hidalgo-González, The greenhouse gas mitigation potential of university commuting: A case study of the University of León (Spain), Journal of Transport Geography, Volume 82, 2020, 102550, ISSN 0966-6923, https://doi.org/10.1016/j.jtrangeo.2019.102550.

[4] Shin Huoy Terh, Kai Cao, "GIS-MCDA based cycling paths planning: a case study in Singapore", Applied Geography, Volume 94, 2018, Pages 107-118, ISSN 0143-6228, https://doi.org/10.1016/j.apgeog.2018.03.007.

[5] Decision of the President of the Republic of Uzbekistan, 02.02.2022 PQ-111-num. https://lex.uz/docs/-5847479

[6] Traffic accident statistics report by the Ministry of Internal Affairs of Uzbekistan. Retrieved from https://yhxx.uz/oz/statistics/2022-jil-davomida-respublikamiz-jllarida-sodir-blgan-jl-transport-odisalari-bjicha-talil

[7] Adam, M.; Cottet, M.; Morardet, S.; Vaudor, L.; Coussout, L.; Rivière-Honegger, A. Cycling along a River: New Access, New Values? Sustainability 2020, 12, 9311. https://doi.org/10.3390/su12229311

[8] R. Marqués, V. Hernández-Herrador, M. Calvo-Salazar, J.A. García-Cebrián; How infrastructure can promote cycling in cities: Lessons from Seville, Research in Transportation Economics, Volume 53, 2015, Pages 31-44, ISSN 0739-8859, https://doi.org/10.1016/j.retrec.2015.10.017.

[9] Ross Owen Phillips, Torkel Bjørnskau, Rolf Hagman, Fridulv Sagberg; Reduction in car–bicycle conflict at a road–cycle path intersection: Evidence of road user adaptation?, Transportation Research Part F: Traffic Psychology and Behaviour, Volume 14, Issue 2, 2011, Pages 87-95, ISSN 1369-8478, https://doi.org/10.1016/j.trf.2010.11.003.

[10] Michal Bíl, Richard Andrášik, Jan Kubeček; How comfortable are your cycling tracks? A new method for objective bicycle vibration measurement, Transportation Research Part C: Emerging Technologies, Volume 56, 2015, Pages 415-425, ISSN 0968-090X, https://doi.org/10.1016/j.trc.2015.05.007

# Information about the author

| | |
|---|---|
| **Sodikov Jamshid** | Tashkent State Transport University, Dept of Highway engineering, Tashkent, Uzbekistan<br>E-mail: osmijam@gmail.com<br>https://orcid.org/0000-0002-4005-9766 |
| **Musulmanov Kuvonchbek** | 2Tashkent State Transport University, Dept of Highway engineering, Tashkent, Uzbekistan<br>E-mail: kuvonchbek.musulmanov@gmail.com<br>https://orcid.org/0000-0001-8906-9909 |
| **Adizov Dilshodbek** | Tashkent State Transport University, Dept of Highway engineering, Tashkent, Uzbekistan<br>E-mail: adizov1779@gmail.com<br>https://orcid.org/0009-0008-2988-4061 |