

Evaluation of Bicycle Transportation Experiences and Bicycle Planning in Turkey, Land Use – Praxis Based Model Proposal

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ABSTRACT

Today, the bicycle is one of the best-accepted means of transport modes of the world within the framework of sustainability. The effort which governments make to make bicycle transport widespread has been formed through making plans for bicycle transportation and carrying them out in the physical environment. In this study, the lawful framework for bicycle use and its regulations in Turkey, and regulations about bicycle transport planning of some cities whose transportation master plans have been analyzed. As a result of the examinations made, the proposal of a bicycle transport planning model based on the land use-transportation-praxis trio has been improved. This proposal defines the advancement of the bicycle transportation network from immediate surroundings to farther, larger-scale land use, primarily from the praxis of bicycling of people as a hobby to more comprehensive demands in which bicycle use is needed to go to work. It has been concluded that according to the developed model, while the activity of cycle transport planning is made in new areas, bicycle transport praxis of the residents, as in the model, should be organized in coordination with land use and in the framework of preparation> organizing>moving stages.

Keywords: Innovativeness, Autonomous Delivery Vehicles, Structural Equation Modeling

Introduction

Individuals desire to reach various places in their lifetime. The use of vehicles with the desire to reach places is simply defined as transportation. Transportation has an important effect on people's quality of life. It is seen that there is social exclusion and high unemployment rates in places where there is poor transport diversity; on the other hand, the effects of problems such as safety, health and noise have increased in places where transport diversity is wide. The increase of the diversity of travel modes in changing the life conditions of people shows parallelism with the economic structure approaching the upper level. Under these circumstances, the effect of travel on people's life quality and its being open to an ever changing and transforming process in terms of planning turns it into an important research subject (Boisjoly and Yengoh, 2017).

The main function of the concept of transportation includes changing places of people and goods physically in the network of places with the aim of providing economic and social sustainability (Miller, 2018). Evaluating transportation in the network of places as a system should be seen as a consequence of the efforts of the community to regulate and organize the environment it is in, in a manner that it can get the maximum benefit. Equality of spatial network in which there is the concept of transport in the physical environment are cities (Mueller, Rojas-Rueda, Basagaña, Cirach, Cole-Hunter, Dadvand and Nieuwenhuijsen, 2017).

Transportation plans are suggesting transport systems that are strategical documents which give an output of solution approaches and proposals as the final product. This output is shaped according to the quality of the place and the necessities of that place where the transport plan is made. Therefore, transportation planning in the urban transport notion is the instrument of putting the decisions into action which is multidisciplinary, and which has a political and technical aspect (Vigar, 2017).

The output as a result of transport planning can be products such as decisions, mechanisms, policies, infrastructure and the like to establish urban place-to-place connections or to strengthen the existing connections. For instance, as a result of the plan, infrastructural recommendations suggested by the plan can become different in line with the technological factors. This differentiation lies from full mechanical vehicles requiring low-tech like bicycles, which transform the human muscular strength

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Submitted: 18.06.2023 • **Revision Requested:** 26.09.2023 • **Last Revision Received:** 23.10.2023 • **Accepted:** 03.11.2023



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into movement to vehicles requiring high technology such as drones, which convert the electrical and electromagnetic energy into motion, magnetic levitation trains, metros, and vehicles of light rail systems.

The rapid increase of resource consumption today and its coming to the agenda of local administrations has put the concept of sustainability in a key position for transportation master plans (Sayyadi and Awasthi, 2018). From the viewpoint of transportation, bicycles having people gain high efficiency in the context of economic, environmental and social sustainability reveals that it has become such an attractive mode of transport (Koglin, 2015).

Bicycle transportation in the perspective of urban transportation indicates individual's direct or indirect transport through the bicycle s/he will use for the destination to which s/he is going. In direct bicycle as a transport mode, the use of bicycles can be realized on the route between the two destinations without the need to use any other kind of transport. As an indirect transport mode, an integrated use with public transport or pedestrian journey which requires the use of bicycle use between two distances for a while can be carried out. According to a research by Woods and Masthoff (2017), it has been stated that even though transport types such as cars and public transport are widespread in urban transport, bicycle use has got a statistically significant superiority ($p < 0.001$) over both types of transport for its being preferred especially for the purpose of both transport and fun.

A study examines bicycle usage habits in low-income neighborhoods and states that the usage of bicycles in low-income neighborhoods can be an important investment tool in preventing inequality in terms of ensuring healthy living conditions (Noyes et al., 2014). Another study underlines that providing bicycle infrastructure in high-density areas is seen as a strategic issue. High population density, urban flooding from heavy rains, and the use of the bicycle network are strict to each other (Clemente, 2020).

With the car being widespread, problems like the increase of traffic congestion, parking problems, the decrease in the quality of life, increasing pollution and the increase in traffic accidents increasing the demand for bicycle use is taking place in urban transport planning (Hickman and Banister, 2014). Ever-increasing interest in the topic of bicycle in urban transportation plans continues its development being in search of activities to increase the rate of bicycle transport in travel actions focusing on urban environment (Fishman, 2016). At the beginning of these activities come transport plans including the factor of bicycle or undertaking the creation of a bicycle oriented transport system as a duty. Planning bicycle transportation is in the study field of transportation specialists, urban planners, and of many departments directly related to the discipline of planning.

Today, many difficulties have been experienced in planning bicycle networks in Turkish cities. Even if a bicycle route is planned and put into effect, the rate of usage might remain in low levels. Deficiencies caused by the legislation related to bicycle transport in Turkey, and maladaptation's experienced in integrating samples of different countries into transportation systems in Turkey are the matters of concern here. Due to many natural and unnatural thresholds in cities, various problems and cases for which some solutions should be created arise in bicycle oriented transport planning. Legislation's lacking many aspects about bicycle transport in academic literature leads us to the result that planning of bicycle transport and the related applications are insufficient in certain aspects.

In the content of this study, the aim of revealing the existing situation of bicycle transportation planning in Turkey, studies about bicycle transportation planning in the scope of transport master plans have been examined in detail. Furthermore, the proposal of a bicycle transportation planning approach has been developed as a model based on the relationship between the bicycle using praxis, bicycle transportation and land use.

Legislative Administrative Framework for Cycling and Bicycle Transportation Planning in Turkey

Bicycles, which many people from the young to the elderly prefer in urban transport, and which is an environmentally-friendly non-motorized type of transport (Li, Wang, Yang and Ragland, 2013) is a kind of transport used in a great number of cities in Turkey.

The framework on bicycle use and its elements takes place in the *Regulation on Bicycle Routes on Urban Roads, on the Design and Construction of Bicycle Stations and Bicycle Parking Lots* (2015) published in the Turkey Official Newspaper dated November 3, 2015, and numbered 29521, and in the *Regulation of Bicycle Routes* published in the Turkey Official Newspaper dated December 12, 2019, and numbered 30976, and in the *Guidebook of Inner City Cycle Routes* prepared by Ministry of Environment and Urbanization. What quality and quantity factors for the planning of cycle transportation such as bicycle ways, bicycle lanes, bicycle track and the like should have, types of bicycle ways and regulations on other important issues were handled in this context. Details arranged in this context are included in Table 1.

Table 1. Guiding documents for planning the bicycle and its elements

Regulations and guidance	Planning cycle routes	Types of cycle paths
<p><i>Regulation on Bicycle Ways on Urban Roads, on the Design and Construction of Bicycle Stations and Bicycle Parking Spaces</i>(2015) published in the Turkey Official Newspaper dated November 3, 2015 and numbered 29521</p> <p><i>Regulation of Bicycle ways</i> dated December 12, 2019 and numbered 30976</p>	<ul style="list-style-type: none"> • Bicycle ways are constructed primarily on places where the topography is available for the purpose of satisfying transportation needs of cyclists and ensuring their safe crossing at the intersections and at the forks in the road in the flow of traffic and they are designed as to form a network to connect the transportation points with the central areas of settlements. • It is planned as a comprehensive network connecting residential areas, transportation points, sports complexes, and intensively used public and private service areas with each other and integrated with other types of transportation with the purpose of meeting the need of transportation safely. • The most convenient route for bicycle is preferred according to topography. • It is planned as to be able to make it go from the origin point to the destination without interruption. • Bicycle ways are planned on the right side of the carriageway in the same direction as the carriageway or bidirectional. 	<ul style="list-style-type: none"> • Bicycle ways to be built on the pedestrian sidewalk • Bicycle ways to be built on the carriageway • Bicycle ways to be built in parks and gardens • Bicycle stations and bicycle parking spaces • Design principles for bicycle stations and bicycle parking spaces • Shared bicycle path • Bicycle lane segregated cycleways • Bicycle track • Bicycle paths • Rural cycling bands • Bicycle highways • Bicycle bridges and tunnels
<p>Ministry of Environment and Urbanization, <i>the Guidebook of Inner City Bicycle ways</i> (2017)</p>	<ul style="list-style-type: none"> • While determining the route for bicycle ways • Planning studies • Analyses based on finding out the appropriate bicycle route • Representation of the route in the zoning plan • Creating the model of mapping out the route and mentioning the details 	<ul style="list-style-type: none"> • Projecting bicycle ways • Bicycle way to be built on pedestrian sidewalk • Cycle way to be constructed on the carriageway • Pilot project of bicycle way

The lawful and management framework for bicycle transportation in Turkey, in brief, mentions the safety of the bicycle as an environmentally friendly means of transportation, its efficiency, its parking, the design of the bicycle and its elements when bicycle-focused policy and strategic approaches are taken into consideration. It can be seen that various physical regulations have been established for the aforementioned elements for bicycle use in many cities such as Istanbul, Izmir, Ankara, Konya, and Eskisehir in Turkey. Yet, in some of the regulations, implementation is carried out by evaluating a legally and an administratively limited scope. Socio-spatial development, land use, transportation structure and features of every city may be different from each other, thus, while this limited framework is applied by transforming the theoretical infrastructure into practice, it may cause some application problems as a result of the solutions left to the initiative of the urban actors. Due to this situation, it is of crucial importance to produce new planning methods and solutions examining the national and international literature on bicycle transportation in Turkey.

Theoretical Background

The bicycle, which has become an alternative transport trend today, is highly influenced by the structure of land use. Researches have emphasized that there exists a statistically high correlation between bicycle use and land use (Zhao, Fan and Zhai, 2020).

Studies and planning experiences carried out about bicycle use reveal that the inclusion of the bicycle as a transport mode in transport planning indicates that it is necessary to focus on both the existing land use and the profile of the people demanding bicycle use. The probability of people choosing the bicycle to access from one point to another in the urban area differs from city to city. Within this scope, the literature explains why there have been many reasons for the preference of bicycle use with the state of having the qualities of land use such as a quality bicycle way, a well-built environment, and useful urban utilizations

(Mateo-Babiano, Bean, Corcoran and Pojani, 2016; Karpinski 2021). The relationship of the qualities of land use with external components like climate and topography is effective in shaping the formation of bicycle routes (Cervero, Denman and Jin, 2019).

Research studies conducted on planning bicycle routes indicate that the use of land is effective not only in the distribution of the origin point and destination but also in the increase of the intensity of the desire for bicycle use. It is emphasized that being close to green areas, especially in this respect, increases the time of cycling; and the abundance of open and green spaces such as parks and grass makes a positive contribution to the increase of bicycle use. In a similar way to this usage, university zones are stated to be more likely to attract the demand for bicycle transportation. Central business districts follow finally in the attraction ranking of this transportation demand extending from green spaces into public spaces. Land use being in a mixed structure and the increase in the quality of the landscape are also among the factors that increase the use of the bicycle. In equipping a residential area as convenient for bicycle transport; presence of suitable conditions for bicycle, existence of places where bicycle-oriented infrastructure can develop, having the linkage between streets and main roads provided are among the important matters (Zhao, Ke, Lin and Yu, 2020).

With the implementation of the plan and project activities, rearrangement of the built-up areas is the situation that requires financial resource. In this case, the steps that will provide the least resource consumption for the efficient use of financial resources and sustainability should be identified through feasibility studies and preferred. It is emphasized that in constructing new bicycle routes, planning of these routes based on waterways, parks and open spaces leads projects to feasible results. It is stated that the routes constituted via this approach create an esthetic beauty and delightfulness in the urban environment along the route, especially in land use groups where high-density housing areas are located, and increase the number of bicycle rides (Cervero et al., 2019).

Another aspect that planning experiences point out to draw attention in the planning of bicycle transportation is the person who is the cyclist or the cyclist-to-be. The city has a structure of accommodating many different human profiles. This situation causes various spatial reflections on the demand for transportation. Designing a rail system for places where transportation demand is high, and pedestrian ways and bicycle ways for places where environmentally valuable components exist can be given as an example of this case. Therefore, the city is affected in a way as to transform the upper scale land use into a mixed one based on the demands. This situation is also seen in the diversity of the profiles of cyclists' being in need of different infrastructure concerning bicycle transport, which can be seen in many studies likewise.

In residential areas lacking bicycle ways, having few cyclists or poor infrastructure, bicycle planning studies usually focus on the potential rider group, and at the beginning of planning, approaches to draw prospective cyclist's attention to the bicycle are seen as the first step in the transportation strategies. Ensuring that the bicycle is preferred for daily commutes is seen as the last step. In theory, the group which takes place in the first step in terms of bicycle planning consists of prospective cyclists who want to practice cycling and who are affected by the attractive components the place offers which allow them to do practice (Larsen, 2016). Aside from this group of users taking place in the first step, other users who have priorities such as riding the bicycle as a lifestyle for recreation, riding it every other day, riding it when they are not busy, or riding it at specific times are emphasized to be in the recreational lifestyle group of riders. The professional group which is the third group seeing the bicycle as a means of transport meeting the demand professionally in the most extreme conditions follows this group (Piwek, Joinson and Morvan, 2015). In terms of the characteristics of the bicycle rider, bicycle use might be vary depending on social variables such as social norm, and social identity. This differentiation may create a change in people's attitudes and perceptions toward cycling at different steps. Researches in bicycle planning which is to be made on a new residential area suggest the preference of approaches providing the increase of images which will encourage cycling, strengthening the positive perception of people for bicycle use, whose effect is powerful (Gatersleben and Haddad, 2010).

As for Turkey, bicycle transport planning, as stated previously, has a background plan within the scope of limited lawful and management framework taking some specific features of cities into consideration. Within this context, it may both remain superficial and bring some failures in the application phase with it. Comparing the accomplished and approved projects of bicycle transportation that take place in the transportation master plan examining them has the guiding role in the model to be produced for the bicycle transportation in the scope of this study.

There are no other studies in the literature that focus on the transportation master plans in Turkey in the context of making a comprehensive evaluation in terms of the particular preference of bicycles, from the perspective of modal distinction, socio-economic structure, transportation pattern, and land use pattern. This study includes the contribution level of the legislation to bicycle transportation planning, the examination of worthy parameters and their level of importance for bicycle planning in research, and the comprehensive evaluation of transportation master plans for bicycle transportation plans. Moreover, in today's transportation planning discussions, where the understanding of sustainability and mobility is evaluated especially within the framework of the pandemic and the rational use of scarce resources, it proposes a bicycle-oriented model approach in the land use - transportation planning setup for cities. In light of the literature, the proposed model groups potential bicycle users and areas

where bicycles will be used, and explains the transportation planning steps within the framework of these groups. In the model which consists of 3 stages, the planning strategy starts with small-scale neighborhood parks to help people who do not have a habit of using bicycles to acquire this habit, and in the next stage, as the group in question acquires the habit and for people who already have this habit as a leisure activity, small-scale uses are transformed into medium-scale land use types, recommends that it be integrated with the route. In the last stage, it is clarified that bicycle transportation, which is thought to be preferred in daily transportation, will be used effectively as a transportation mode in the city's large-scale land uses that attract passengers after all integration between land use types is achieved. It should be noted that bicycle planning should not remain in two dimensions, and the socio-economic structure of the region where planning activities are should be considered also in the planning process.

Material and Method

Within the scope of the study, different urban sizes, demographic structure, structure of land, urban uses, transportation patterns, and comparison of cities having different characteristics have been made. Cities whose comparison has been made have been determined as İstanbul, Ankara, Mersin, Antalya, İzmir, Sakarya, Erzurum, Muğla, Malatya, Erzincan and Rize. In this comparison, as seen in Figure 1, setting forth things carried out within the context of the projects on bicycle transportation taking place in accomplished and approved transportation master plans on the basis of both metropolitan cities and small and medium-scaled cities, and evaluating the present situation have been taken as the basis.



Figure 1. Cities which transportation master plan was examined in Turkey

Examination of Transportation Master Plans in Terms of Cycling

In the content of accomplished and approved transportation master plans in Turkey for bicycle and bicycle transportation planning, which is the main focus of interest of this study, the data collected during the preparation phase has been shown in Table 2, including the population of current and project target year and income distribution of the city. In Table 3, the transportation structures of cities whose transportation master plan was made and the evaluation of bicycle use have been presented. Within this framework, vehicle ownership in the city, modes of vehicle used in urban transportation, all of the travel-to-type of vehicle ratio, and differences in bicycle use according to level of income/employment status have been revealed explicitly. In Table 4, on the other hand, there are evaluations about the newly collected data with the help of surveys and observations within the scope of transportation master plans. Accordingly, the intended purpose of bicycle use in cities, the reason why bicycle is preferred, identifying the arising problems with respect to bicycle use in cities, and suggestions within the scope of the plan for bicycle use have been compared. The aim of comparing these data, in particular, is to reveal the relationship between bicycle use or preferable with the help of tables concerning the current situation in cities and the research areas.

Evaluation of Demographic Structure in Cities with a Transportation Master Plan

Although accomplished and approved transport master plans in Turkey are not chosen from the cities with a specific population, they include metropolitan, small-scale and medium-scale cities. Among these cities, while İstanbul, Ankara, Mersin, Antalya, İzmir, Sakarya, Erzurum, Muğla and Malatya are in the status of metropolitan, Erzincan and Rize are called small and medium scale cities. In this context, when an evaluation is made according to Table 2, it can be concluded that people with a middle or low level of income are the majority in these cities where transportation planning is made. When an evaluation is made according to the

level of education of citizens, it is seen that people with different levels of education are found in each city. One of the reasons for the emergence of this difference may also be the fact that the data in the content of every transport plan was collected according to the information providing different levels of education. However, the population of primary-secondary and high school education level can be said to be in the majority. In terms of the age distribution of the population that cities have; just as in their levels of education, collecting the data according to different age groups reveals the difference in percentage distributions. All in all, it can be concluded that the population of young and middle age is in the majority in parallel with the general age distribution in Turkey.

Table 2. Socio-demographic structure of cities whose transportation master plans have been made

Transportation Master Plan (TMP)	TMP Project Period	Current Population in the Plan Year (persons)	Income Distribution of the City (Turkish Liras TL)
Mersin Transportation Master Plan (2016)	2016-2030	955.106	3000 TL and above 9.3% Between 1001-3000 TL 46.2% 0-1000 TL and above 44.5%
Antalya Urban Transportation Master Plan (2013)	2013-2030	1.024.583	Upper Income Group 7.15% Middle Income Group 54.88% Low Income Group 37.97%
İstanbul Metropolitan Area Urban Transportation Master Plan (2011)	2011-2023	13.209.007	No data
Rize Transportation Master Plan (2018)	2017-2032	111.573	No data
Malatya Transportation Master Plan (2017)	2017-2035	772.904	Upper Income Group 5,0% Middle Income Group 44,80% Low Income Group 50,3%
Ankara Transportation Master Plan (2013)	2013-2038	5.045.083	Upper Income Group 23,30% Middle Income Group 42,50% Low Income Group 31,90%
Erzincan Transportation Master Plan (2017)	2016 - 2032	131.970	Upper Income Group 0,60% Middle Income Group 78,2% Low Income Group 21,2%
Muğla Transportation Master Plan (2018)	2017-2030	938.751	Upper Income Group 18% Middle Income Group 62% Low Income Group 20%
Sakarya Transportation Master Plan (2011)	2011-2023	888.556	Upper Income Group 2,5% Middle Income Group 30,2% Low Income Group 67,3%
Erzurum Transportation Master Plan (2013)	2012-2030	381.804	Upper Income Group 1,7% Middle Income Group 17,6% Low Income Group 80,7%
İzmir Transportation Master Plan (2017)	2015-2030	3.920.224	No data

Transportation Structure and Bicycle Use in Cities with a Transportation Master Plan

When their structure of transportation and case of bicycle use are analyzed; while most of the cities have current types of transport like car, taxi, motorcycle, bus, minibus and service/shuttle, in cities like İstanbul, Ankara, Antalya and İzmir, their rail systems have also been developed depending on the size of transport macroform of the cities. Sea transportation also takes place in cities like İstanbul, İzmir and Muğla, additionally.

In most of the cities, the rate of transportation by bicycle remains below 1% on urban journeys, only in Mersin, it is at the rate of 1.1%, in Muğla at the rate of 1.67% and in Sakarya 1.4%, and it is seen through these rates that there is a higher rate of bicycle use in these three cities compared to other cities. If we evaluate the rates given here with Table 3, in the cities of Mersin, Muğla and Sakarya, where people in the young and middle-aged group have a rate of 80% in age distribution, bicycle use being more on urban journeys is the indication of young and active population's using bicycle more intensively.

When the use of bicycle in the city is examined according to the income group or status of work, it is noticeably seen that mostly people with low income and middle income prefer bicycle transportation.

Table 3. Transportation structure of cities whose transportation master plan has been made and bicycle use

Transportation Master Plan (TMP)	Distribution of all trips by vehicle types	
Mersin Transportation Master Plan (2016)	40% Pedestrian	3.8% Municipal bus
	19.9% Car	1.5% Motorcycle
	0.5% Taxi	1.1% Bicycle
	19.9% Minibus	0.1% Commuter-Train
	11.8% Service/Shuttle	0.4% Other
Antalya Urban Transportation Master Plan (2013)	29.8% Pedestrian	0.96% Bicycle
	19.53% Car	0.47% Taxi
	28.4% Minibus/Bus	0.1% Rail system
	15.9% Service/Shuttle	0.22% Tram
	2.42% Motorcycle	0.77% Other
İstanbul Metropolitan Area Urban Transportation Master Plan (2011)	49% Pedestrian	2% Rail systems
	15% Cars and taxis	1% Steamboat-ferry
	32% Minibus and bus,	
Rize Transportation Master Plan (2018)	40.7% Pedestrian	
	24.51% Car	0.07% Bicycle
	29.56% Minibus	0.4% Taxi
Malatya Transportation Master Plan (2017)	0.17% Motorcycle	0.05% other
	50.8% Pedestrian	0.1% Private Public Bus
	16.3% Car	0.1% Motorcycle
	8.3% Minibus	0.1% Bicycle
	10.7% Service/Shuttle	0.4% Taxi
Ankara Transportation Master Plan (2013)	11.5% Municipal Bus	1.9% Trambus
		0.8% Other
	27.91% Pedestrian	8.66% Service/Shuttle
	21.69% Car	0.07% Motorcycle
	5.62% Rail system	0.08% Bicycle
Erzincan Transportation Master Plan (2017)	24.67% Bus	1.00% Taxi
	9.99% Minibus	0.31% Other
	38.08% Pedestrian	
	25.90% Car	0.77% Motorcycle
	17.37% Bus	0.81% Bicycle
Muğla Transportation Master Plan (2018)	8.44% Minibus	0.34% Taxi
	6.31% Service	1.98% Other
	33.96% Pedestrian	
	26.48% Car	1.67% Bicycle
	7.24% Bus	0.59% Taxi
Sakarya Transportation Master Plan (2011)	7.98% Minibus	0.05% Watercraft
	6.86% Motorcycle	13.81% Service
	48.6% Pedestrian	
	11.3% Car	0.8% Motorcycle
	10.6% Minibus	1.4% Bicycle
Erzurum Transportation Master Plan (2013)	10.0% Service/Shuttle	0.3% Taxi
	7.7% Bus	3.4% Other
	51.3% Car	
	3.2% Minibus,	3.2% Bus,
	24.1% Service/Shuttle	12.1% Taxi,
İzmir Transportation Master Plan (2017)		5% other (includes bicycle)
	19.1% Car	4.0% Suburban rail
	0.6% Taxi	18.9% Bus
	1.1% Motorcycle	6.6% Minibus
	0.5% Bicycle	0.5% Steamboat
	0.2% Taxi minibus	
	0.1% Conventional Train	
	0.3% Other	

Current Situation Analysis and Suggestions for Cycling in Transportation Master Plans

When the current situation for bicycle transportation in cities whose transportation master plan has been made is evaluated, considering the intended use of the bicycle according to Table 4, it is used for the purpose of sport-exercise at a rate of 48.9%, of reach to work at a rate of 24.4%, and of reach to school at a rate of 8.9% in Mersin; and in Antalya the bicycle is used for the purpose of work at a rate of 47.9%, for socio-cultural activities at a rate of 25.9%, and for the purpose of business follow-up at a rate of 15.4%; on the other hand, the bicycle is used for work at a rate of 47.5%, for the purpose of education at a rate of

11.4%, for paying a visit to friends at a rate of 9.8%, and for socializing at a rate of 9.8% in Ankara. In addition to these, it has been determined that the bicycle is used for the purpose of transportation in Rize, for shopping-socializing-recreation in Erzincan, for recreation and transportation in Muğla and in İstanbul, for the purpose of work-education-trip-socializing in İzmir, Erzurum and Malatya, and for work-trip-shopping-health in Sakarya. When all of the cities are evaluated on this basis, the conclusion that citizens use bicycle for business and work primarily, and after that they use the bicycle as a means of socio-cultural activities, and means of sport-fun-recreation, and afterwards with the aim of getting to school can be reached.

The reasons for the preference of bicycle are; due to health reasons at a rate of 29.7% and for the purpose of not polluting the environment at a rate of 2% or 3% in Mersin; in Ankara and İstanbul it is used for healthy life, for not polluting the environment and as an alternative mode of transportation to motorized transportation. Bicycle using is seen as a traditional transportation alternative in Antalya. It is preferred in Erzincan because it is not affected by traffic congestion and because of its short travel distance; and it is preferred because it is economical in short distances in Rize; in Erzurum it is preferred in terms of health and due to short travel distance; and in Muğla it is preferred so as not to get affected by traffic jam, for its short travel distance, because it is economical, and as it is a sustainable transportation alternative.

When the problem about bicycle is evaluated, which has been made in the content of transportation plans; not having enough space for bicycle lanes at a rate of 28.7%, and having no bicycle parking places at a rate of 18% in Mersin are in the first rank. The insufficient bicycle ways in Ankara at a rate of 25.9%, the lack of safe ways to bicycle on at a rate of 21.0%, the insufficiency of parking places for bicycle at a rate of 18.4%, drivers'/riders' irritating behaviors at a rate of 16.9%, and not being able to get on the public transport with the bicycle at a rate of 14.5% considered as important problems. In İstanbul, the effect of traffic density on bicycle transportation, not having a good infrastructure belonging to bicycle; in Antalya lacking bicycle parking places, bicycle using in the mixed traffic and problems of integration between public transport and bicycle are some certain problems regarding this issue. The biggest problem in Rize is ignoring bicycle transportation and the topography which is not convenient for cycling. Having no convenient infrastructure for bicycle and the pressure of motorized vehicles in Muğla and Sakarya are other factors causing problems. Other important factors are the climate and physical conditions creating problems in bicycle transportation in Erzurum.

Suggestions improved for bicycle transportation in the content of transportation master plan are presented in detail in Table 4.

When suggestions improved for bicycle transportation within the scope of transportation master plan; It is seen that the young population of cities who receive primary, secondary and high school education constitutes approximately 50% of the total educated people. Providing the areas of educational institutions with bicycle transportation is important for this group of youngsters to gain the praxis of bicycle transportation. Especially low and middle- income groups constitute 70-75% of the income distribution of the city. Therefore, it is a critical issue to project bicycle transportation, which is economically a cheap alternative, in such a way that initially these groups will benefit from it. A variety of transportation modes that are available for bicycle integration have been seen in all cities. Transportation policies that will turn this situation into an advantage are considered to be beneficial in terms of sustainability.

All in all, it is seen that bicycle transportation is a mode that has a little share among all journeys in Turkey. It is also seen that bicycle transportation is preferred for reasons such as recreation, bicycle touring, socializing, education, shopping, and commuting to work. Applications of bicycle path, bicycle parking, and networking are among the most common applications. Bicycle is seen to give a good performance in issues such as health, environment, traffic congestion, and being economical in terms of transportation. Within the scope of a model produced in the light of these findings, it is understood that the development of the approaches of bicycle transportation planning can be beneficial in terms of transportation and sustainability.

PROPOSAL MODEL

In the study, the focus was on transportation master plans, for which transportation master plan reports were available as of the period in which this study was produced, and where specific determinations were made regarding bicycles, and all these reports were compared with each other and a current situation analysis was carried out. The study focused on transportation master plans that could be obtained and made specific determinations about bicycles. The basic data compiled together with the comparative current situation analysis of the reviewed literature, legislative framework, and transportation master plans also form the basis for the conceptual framework of the study during the 3-stage model production.

A planning model that focuses on land use and people has been proposed for bicycle route planning taking the approaches that have been expressed in the content of literature into consideration. For the planning of model bicycle route, it includes primarily cyclists or prospective cyclists in the area, if any, and the determination of the features, attributes of the route in terms of land use. In the model, bicycle user profile has been evaluated as; there exist users in the first group that do not have the praxis of cycling, and in the second group take place bicycle users who are used to cycling at an average level, and in the third; users that

Table 4. Current case analysis of cycle transportation of cities whose transportation master plan has been made

The Name of Transportation Master Plan	Suggestions on Bicycle Transportation
Mersin Transportation Master Plan (2016)	<ul style="list-style-type: none"> • Suggestion of a 63-kilometre bike path in the short term, in the medium and long term 77-km cycle way suggestion • Bicycle lane • Shared bicycle way • Integration between the bicycle and public transport system • Smart cycling system • Bicycle parking spaces • Direct access to the distance of cycling • Rental bicycle system in the city center • Suggestions for bicycle ways for the purpose of transport in the short, medium and long term, bicycle ways for recreation and sport • Increasing the safety of pedestrians and cyclists through a city center whose motorized vehicles have been decreased
Antalya Urban Transportation Master Plan (2013)	<ul style="list-style-type: none"> • Creating the network of widespread cycleways and cycle lanes • Creating bicycle parking places and safe and regular bicycle parks • Increasing the use of bicycle of car drivers and tourists with the project of a city bicycle (bicycle for rent) which has widespread stations • Bicycle paths and lanes, bicycle parking places
İstanbul Metropolitan Area Urban Transportation Master Plan (2011)	<ul style="list-style-type: none"> • Transfer central areas providing the integration among different transportation modes such as rail systems (metro, light metro, tram, funicular and the like), highway systems (bus, minibus, metrobus, private car and taxi and the like), seaway system and transportation systems of cyclists and pedestrians have been planned • Cycle ways which have sustainability should be built to make cycle transportation an important mode of transportation in urban journeys. • For the popularization of bicycle use, roadside or off-street parking lots for bicycles, on some parts of car parks, around central facility functions, and at public transport access points should be designated; this mode of transport should be integrated with public transport.
Rize Transportation Master Plan (2018)	<ul style="list-style-type: none"> • Regulations for bicycle journeys in the city center. • Applications of routes for cycleways in the city, roads with a low volume-to-capacity • Bicycle parking places should exist at important public transport stops and at vehicle transfer points. • Bicycle paths and cycle lanes should be made integrated with public transport stops. • While the bicycle path recommended to intended for recreational use; cycle paths recommended to be constructed in the medium term integrate the university, city center and residential areas on one axis. This arrangement should be made taking the use of public and green spaces into account. • The first stage cycle way, 17 km long along the coast and the second one on Atatürk and Cumhuriyet Street and approximately 8 km long in total, in parts connected to the coastal road from place to place, are recommended.
Malatya Transportation Master Plan (2017)	<ul style="list-style-type: none"> • Establishment of a bicycle transportation network that can create a ring system. • Bicycle routes to connect public and green spaces • Bicycle lanes
Ankara Transportation Master Plan (2013)	<ul style="list-style-type: none"> • Integrations of bicycle and public transportation • Applications of borrow a bike and return it (Yellow Bike Project) • Developing the standards of bicycle planning • Installation of the database of cyclist's behavior • Bicycle parking spaces
Erzincan Transportation Master Plan (2017)	<ul style="list-style-type: none"> • Creating bicycle ways for recreational purpose • Developing standards for cycle paths • Applications for bicycle parking • Integration of public transport with the bicycle • Constructing bicycle stations • Suggested bicycle routes to connect public and green spaces
Muğla Transportation Master Plan (2018)	<ul style="list-style-type: none"> • Suggestions for regulating one- way bike path • Applications of electric bike • Arrangements of the pedestrian-bicycle mixed-use roads • Project of bicycle in rural area • Bicycle-friendly city
Sakarya Transportation Master Plan (2011)	<ul style="list-style-type: none"> • Suggestions for the regulations of bicycle paths and facilities
Erzurum Transportation Master Plan (2013)	<ul style="list-style-type: none"> • The network for bicycle path • Suggesting bicycle parking space • Construction of bike path connections in the city center, • Providing the integrity of the bicycle network taking the university into consideration, • Application of the intelligent bicycle
İzmir Transportation Master Plan (2017)	<ul style="list-style-type: none"> • Integration of public transport • Cycle ways for recreational purposes • Direct accessibility among towns • Bicycle paths, bridges • Providing access to the city center and suburbs • Paying attention to the matter of accessibility to the centers of transportation by bicycle while planning bicycle paths

are absolutely accustomed to using a bicycle, taking the reviews of literature into consideration. In the model, the group that do not have the praxis of cycling has been treated as the group that is being tried to be attracted to bicycle as a result of planning activities; and the group whose cycling praxis is at an average level has been regarded as the group using bicycle for the purpose of sport and hobby in their lifestyle without any planning activities; and lastly the group whose praxis of bicycle use is full has been considered as the group that supplies the demand for transportation by bicycle, especially in commuting to and from work, in the professional meaning (See Figure 2.).

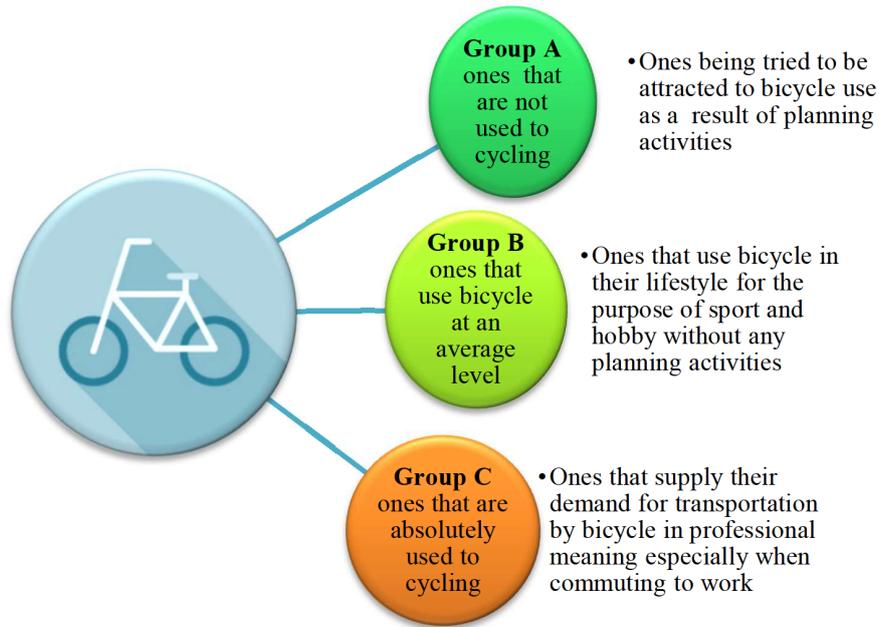


Figure 2. The profile of bicycle user considered in the scope of the model

With reference to the planning experiences, in order to construct a route in a place where there is no existing bicycle route, first of all, it is necessary to have people gain the habit of using the bicycle. Hence, it is suggested that this should be realized in 3 stages in order not to consume all available resources and as users gain the praxis of transportation. According to the proposal model involving this approach, stages in Figure 3 should be followed for the planning of bicycle route somewhere.



Figure 3. Cycle route planning stages by model

The model within this scope;

In the 1st stage, proposes to add bicycle infrastructure to the open and green spaces of a small-scale neighborhood to attract the attention of the group that does not have the praxis of cycling.

In the 2nd stage, aims to have the group that do not have the praxis of cycling gain the praxis of bicycle and aims to have the group using bicycle at an average level increase their rate of bicycle use in various sports and recreational activities. At this stage, small-scale open and green spaces, which were previously equipped with bicycle infrastructure, are combined with each other and with medium-sized open and green spaces, as well as with public space campuses. It is predicted that the land use- transportation coordination, which has been strengthened together with the spatial connections provided, will raise the level of cycling praxis to top levels. In such a situation, as a result of increasing praxis, some users' starting to see the bicycle as a means to meet the transportation demand will make it inevitable to plan the bicycle path connections at upper scales.

In the 3rd stage, bicycle routes that will provide the upper-scale connection of the combinations proposed in the 2nd Stage (for instance, the arrangement of central business districts (CBD) – through parks throughout the city) for bicycle transportation, which will become one of the main modes in meeting the transportation demand, especially for home based - work, home based - school, home based - other journeys have been recommended. The conceptual expression of the proposed model is as follows in Figure 4;

The proposed model mainly focuses on transportation praxis, land use and human interaction. The dimension of the interaction can be expressed as the link established between land use and bicycle user praxis of using transportation vehicles. In this framework, land uses can be explained as the units the size of basic use existing in various scales and bicycle routes can be explained corresponding to the concept of link, which is a reflection of the dimension. From this point of view, the structure

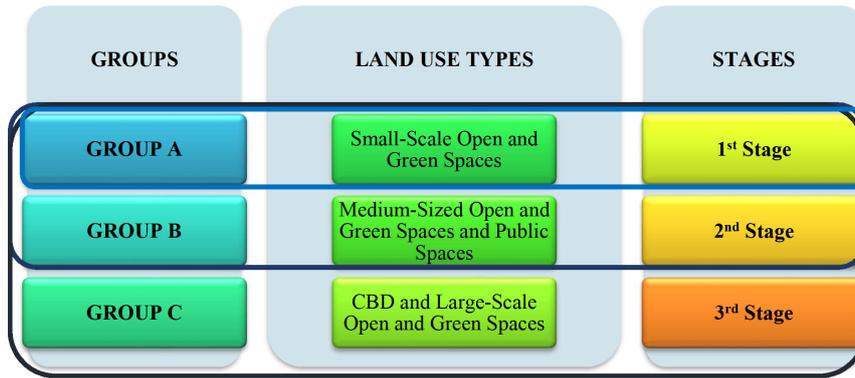


Figure 4. The conceptual expression of the proposed model

of the proposed bicycle planning model resembles just as the molecular models used for the molecular structure taking place in the science of Chemistry to be easily understood. If the whole model is structured as a diagram considering bicycle routes as interatomic bonds and atoms as spaces, we obtain a conceptual form of representation taking place in Figure 5, which we call the molecule model in bicycle route planning.

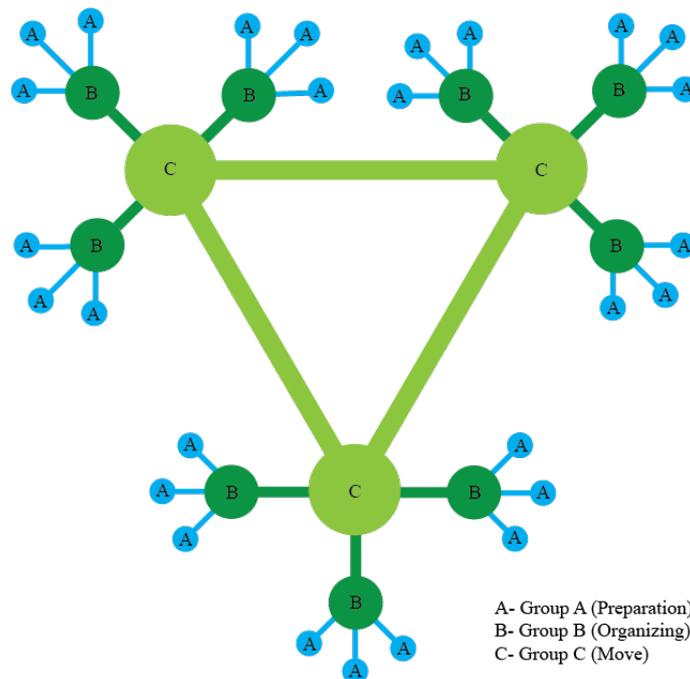


Figure 5. Representation of an imaginary location in bicycle route planning with a molecular model diagram

The sample figure represents a simple hierarchical construction. In accordance with the model, the circles designated as group A are for the representation of the construction of small-scale open and green areas of a residential area for bicycle transportation in the 1st stage which is called preparation in places at neighborhood-scale level. The circles specified as Group B, which is called arrangement at the district-scale level, represent the interconnection of parks at neighborhood-scale level between each other and the interconnection of these parks with other parks and public places that exist in the upper scale. The circles indicated as Group C, on the other hand, represent the center of settlement sizes that have the utilizations such as large-scale parks and central business areas providing the interconnection between the levels that take place below them in the hierarchy despite being at the city-scale level.

CONCLUSION AND RECOMMENDATIONS

The result of planning experiences and the research carried out on bicycle transportation show that the bicycle in transportation is a simple but effective solution providing benefits in terms of sustainability. The legal and administrative framework for bicycle transportation in Turkey cannot go beyond the definition of the bicycle, bicycle parking, how to make the design of bicycle elements such as bicycle paths and routes and cannot develop a proposal according to the characteristics and socio-demographic-economic structure of cities for the planning of bicycle transportation. And this case brings problems with it at the stage of application and bicycle use at the estimated level. Nevertheless, it is seen that differences in terms of implementation are also included in search for planning whose main topic is bicycle transportation on local administrators' and urban actors' own initiative in Turkey. While facilitating the coordination in terms of bicycle transportation and land use, low and middle - income groups being predominant in the cities examined within Turkey, and feeling the effect of young population at the educational level are some of the critical points to be considered and to be given priority. Bicycle transportation planning should not be expressed only in a two-dimensional environment, but it should be a search that is evaluated taking account of sociological structure of the city and transportation praxis of the urban people, as well.

Within the scope of this methodology of study, a proposal model of bicycle transportation-land use- based bicycle transportation planning approach has been developed. In a practical meaning, structuring common types of land use in a scaled manner, a model has been structured in a way as to include a conceptual hierarchical settlement for bicycle transportation planning of a residential area. In other words, the proposal of a roadmap to be followed to use transportation planning studies on bicycle use that have been conducted so far ,and to use bicycle transportation researches in planning activities has been based on the conceptual framework that consists of three main stages in the perspective of transportation, praxis and land use.

It is known that within the framework of sustainability, rational consumption of resources plays an important role in today's conditions. Today, vehicles that consume fossil fuels are the transportation vehicles that are at the forefront of urban transportation. It affects both air pollution and negatively affects the quality of life, thus constituting the main source of the problem. In terms of sustainability, fossil fuel consumption is considered a problem for the authorities, and searches for action that will change this transportation habit, especially climate change, continue. In this study, a land use - transportation planning model is developed that can direct the transition to transportation habits, which has the potential to increase the level of bicycle use in cities, especially in terms of sustainability, and an alternative solution is proposed to change the transportation habit for cars and other motor vehicles.

The planning activities to be conducted for bicycle transportation making use of this conceptual framework, initially in Turkey, are estimated to provide more effective results. Additionally, this study is considered to be a good reference point for the research topics such as priorities in route selection for the bicycle, the criteria of planning the bicycle routes and the selection of suitable routes, and the place of bicycle transportation in terms of transportation habits to be prepared in the future.

Peer Review: Externally peer-reviewed.

Conflict of Interest: Authors declared no conflict of interest.

Financial Disclosure: Authors declared no financial support.

Author Contributions: Conception/Design of Study- H.G.Ö., F.A.; Data Acquisition- H.G.Ö., F.A.; Data Analysis/ Interpretation- H.G.Ö., F.A.; Drafting Manuscript- H.G.Ö., F.A.; Critical Revision of Manuscript- H.G.Ö., F.A.; Final Approval and Accountability- H.G.Ö., F.A.

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How cite this article

Önder, H.G., & Akdemir, F. (2023). Evaluation of bicycle transportation experiences and bicycle planning in Turkey, land use – praxis based model proposal. *Journal of Transportation and Logistics*, 8(2), 148-161. <https://doi.org/10.26650/JTL.2023.1316181>