

Research on the Development Strategy of Bicycle Transportation under the Concept of Green Transportation

Lin Jiali^{a,*}, Xu Shutao^b

City University of Macau, Macau, China

^a 871155360@qq.com, ^b 453979301@qq.com

Abstract: Green transportation is a kind of "people-oriented" environment-friendly transportation, and bicycle transportation is an effective means to realize the development of urban green transportation. Many cities around the world are carrying out bicycle revival work. China used to be a big country of bicycles. In recent years, with the expansion of cities and the sudden increase in the number of cars, the living space of bicycles is gradually shrinking and the number of bicycles is also declining, which is not conducive to the sustainable development of urban environment. Taking Copenhagen as an example, this paper analyzes the development status of bicycle traffic from the three levels of infrastructure construction, laws and regulations, and personal traffic awareness, and summarizes the practical points of the city's bicycle traffic, hoping to get enlightenment from the development of China's urban bicycle traffic.

Keywords: Green transport, Bicycle travel, Copenhagen, Sustainable development

1. Introduction

Bicycle transportation has long been the main mode of transportation in Chinese cities, but with the acceleration of urban development and the increasing number of motor vehicles, the proportion of bicycle travel in many cities is declining. Moreover, due to the problems of travel concept and other aspects, the construction and management of bicycle-related facilities in Chinese cities are still not perfect. Copenhagen is praised as the "city of bicycles", both in terms of bicycle infrastructure construction and bicycle transportation policies. Draw lessons from the successful experience of foreign bicycle traffic development, put forward reference suggestions for the development of China's bicycle traffic, and build a green ecological city.

2. Current situation of bicycle traffic and its importance to green traffic

2.1 Current situation of urban bicycle traffic in China

China was once known as the "kingdom of bicycles". Until 2000, many cities in The country still used bicycles to travel, but now the development of bicycle transportation is worrying^[1]. At present, influenced by the revival of international bicycle transportation, some cities in China have carried out demonstration projects related to "walking and bicycle transportation system". However, bicycle-related planning theories and technical methods are still lacking in China, and the proportion of trips is declining rapidly. By September 2021, there were 390 million motor vehicles in China. At the same time, the share of bicycle travel is decreasing at an annual rate of 2 to 5 percent. It can be seen that the probability of people using bicycles for transportation is low, and most people prefer motor vehicles for daily travel, which is not conducive to the sustainable development of urban green transportation in China^[2-3].

2.2 The importance of bicycle traffic in green traffic

As an important part of green transportation, bicycle transportation has the characteristics of low energy consumption, low pollution and convenience, which has many positive effects on the development of urban transportation. It is mainly reflected in the following aspects:

- (1) Reduce transport land consumption

According to experts' calculations, bicycles not only have a lower per capita traffic area, about half that of cars, but also have a higher road utilization ratio than cars and motorcycles. From the perspective of the road resources occupied by bicycles, the bicycle road space accounts for less than 40% of the urban road space, covering a small area.

(2) Reduce urban traffic pollution

Noise and polluting gases from motor vehicles have become major sources of environmental pollution in China's big cities. Bicycle transportation is a kind of physical transportation mode, so there is no pollution gas emission phenomenon. As a green and healthy means of transportation, bicycles can not only effectively reduce air pollution and noise pollution, but also improve the physical fitness of cyclists.

(3) Ease traffic congestion

Traffic congestion is a common problem in major cities around the world. With the rapid development of motorized urban traffic in China, bicycle traffic is gradually seriously disturbed by motorized traffic, resulting in frequent urban traffic congestion.

(4) Reduce the probability of traffic accidents

According to TRL research in the UK, about 750,000 ~ 880,000 people die in traffic accidents every year around the world, resulting in 23 ~ 33 million injuries. Road traffic safety has become a universal problem facing the world. However, in terms of traffic accidents, the accident probability of bicycle travel is relatively low. Therefore, proper development of bicycle traffic can reduce traffic accidents to some extent.

However, due to the late attention and research on green transportation in China, there are also some problems in practice, which hinder the implementation of green transportation in the process. As the popularity of bicycle culture is not high, and the construction and management of bicycle infrastructure in various cities are not perfect, the problems of traffic congestion and environmental deterioration are still serious^[4]. Therefore, in order to improve the quality of green transportation, it is necessary and urgent to develop bicycle transportation.

3. Copenhagen bicycle traffic overview

3.1 Current situation of Bicycle Traffic

Copenhagen is a leading green city in the world, with the reputation of "city of Bicycles". According to statistics, in 2016, the number of bicycles in the city has surpassed that of cars^[5]. Rush hour in Copenhagen, where 62% of the population commute by bicycle to their work or study places each day (figure 1). In addition to the numbers, the city offers a great experience for cyclists. For example, bicycle lanes in cities are clearly marked; Car parking Spaces do not occupy riding lanes; Bicycles are also allowed on subways, buses and ferries; And ubiquitous bicycle docking stations^[6]. These conveniences greatly improve the public's initiative and enthusiasm for green transportation. According to the current situation of the development of bicycle traffic in Copenhagen, the analysis is mainly carried out from the following three aspects: infrastructure construction, customization of laws and regulations, and personal traffic awareness.



Figure 1. Peak cycle traffic in Copenhagen

Photo source: Wikimedia Commons

Infrastructure construction:(1)Improve lanes and widen the network. There are two kinds of lanes, one is independent, the road surface is covered with blue plastic, no motor vehicles and traffic lights interference; The other is adjacent to the motorway, but the motorway, bicycle path and sidewalk are separated from each other in order of height.In some heavily trafficked areas, bike lanes have been widened to dual lanes to ease the growing traffic(Figure2); (2)Bicycle signal lamp.Some roads in Copenhagen are equipped with bicycle signal priority and "green wave" for bicycles to increase the probability of bicycles meeting green lights and improve the capacity of bicycle lanes.(3)Set up dedicated channels.Passengers are allowed to carry bicycles on special subway and light rail carriages^[7]; (4)Clear lane markings.At junctions with many vehicles in Copenhagen, left-turn road signs are usually set up for bicycles to avoid conflicts between bicycles and right-turn motor vehicles and improve cycling safety coefficient.(5)Build bicycle lanes.In order to provide convenience for bicycle commuting, the travel distance of bicycle is greatly reduced, and the bicycle exclusive lane system is planned, with aerial bicycle lanes and cross-channel channels specially set up(Figure3)^[8]; (6)Build bike parking lots. Special bicycle parking lots are built in cities, and special bicycle parking areas can be seen everywhere in urban areas to provide convenient parking places for cyclists.



Figure 2. Copenhagen's bicycle roads have been improved

Photo source:Wikimedia Commons



Figure 3. The bicycle viaduct in Copenhagen

Photo source: Wikimedia Commons

Formulating laws and regulations:Copenhagen's bicycle development strategy has evolved over time. In 1997, the City of Copenhagen adopted the Bicycle Road Priority Plan;In 2000, the City of Copenhagen adopted the Green Bicycle Route Proposal;In 2001, the city of Copenhagen introduced the Copenhagen Traffic Safety Plan;In 2002, the City of Copenhagen published the Bicycle Policy of The City of Copenhagen 2002-2012;Copenhagen City Bicycle Strategy 2011-2025 published in 2011^[9].The government attaches great importance to the development of bicycles in the city, as can be seen from the bicycle strategic plan that has been constantly updated in recent years.And the policy states that cars must let cyclists take the lead at a junction where there are only crosswalks but no traffic lights. And it's free to park your bike anywhere in Denmark.

Personal awareness of traffic:Copenhagen has made great efforts to promote green travel, and all citizens have a strong concept of green traffic. About half of the local population uses bicycles as their daily commute.The city also holds a national bicycle race every year, which has become a popular part of Danish summer camps.

3.2 Analysis of practical points of bicycle traffic

According to the above research, the bicycle traffic in Copenhagen is studied and the following five factors are summarized(Figure4).

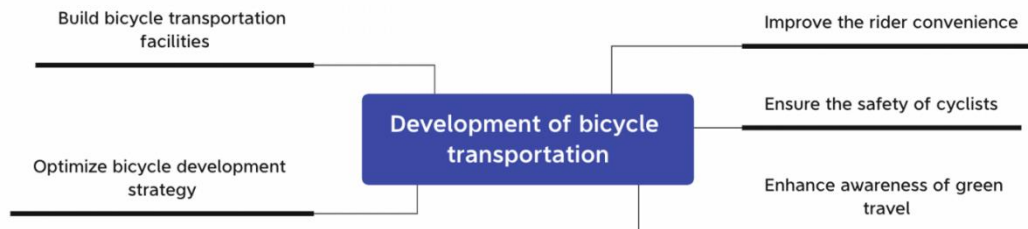


Figure 4. Copenhagen bicycle transportation development practice focus

Photo source:The author

① Build bicycle transportation facilities

The construction of bicycle transportation facilities is mainly reflected in two aspects: improving road network and adding parking spots. Two kinds of bicycle lanes are built to ensure that bicycles and motor vehicles are relatively independent and do not interfere with each other. Widen bike lanes to relieve traffic pressure^[7];At the same time, the construction of bicycle viaducts, easy to cross the intersection, rail, urban highways and other places, so that cyclists can smoothly reach their destinations; The city sets up multiple bicycle parking lots and parking spots everywhere to avoid the trouble of no parking space for cyclists.

② Optimization of bicycle development strategy

The bicycle traffic development strategy has been added into the urban planning and design. Since 1997, the bicycle development strategy has been constantly updated and improved, and corresponding measures have been put forward for the development of bicycle traffic.It includes bicycle green route planning, bicycle parking facilities improvement, bicycle road marking system, direction signs and road intersection safety design, so that bicycle traffic can be optimized for long-term development.

③ Improve the convenience of cyclists

In order to enhance riders' sense of direction, signs and color coding of bicycle lane directions are set up in the traffic Spaces and intersections, aiming to make the signs more clear.Allow passengers to carry bicycles on special carriages of subways and light rail trains to provide convenience for cyclists; And in order to improve the enthusiasm of citizens to ride, all bicycle parking areas in the city are free of charge^[6].

④ Ensure the safety of cyclists

A traffic safety plan for the safety of cyclists; When there is no signal light at the intersection, the formulation of cyclists' priority to pass regulations can effectively reduce the occurrence of traffic accidents, so as to protect the personal safety of cyclists.

⑤ Enhance public awareness of green travel

Comprehensive development advocates green transportation, and the local government carries out various interesting cycling activities to improve the enthusiasm of the people. Actively encourage young people to participate in bicycle races, so that everyone has a profound cultural concept of bicycle.

4. Enlightenment to the development of bicycle traffic in China

4.1 Strengthen the joint development of bicycle transportation and public transportation

Due to the rapid urbanization process in China, the central urban area of almost all cities is rapidly expanding, which also has a negative impact on cycling suitable for short trips. Therefore, it is suggested to formulate policies to encourage the development of urban green transportation at the national level, take the scientific concept of development as the guidance, closely combine the strategy of priority development of public transportation, consider bicycle transportation and public transportation as an integral part of the development of urban green transportation, and plan overall layout and planning.

4.2 Improve bicycle infrastructure construction and strengthen management

At present, the construction of urban bicycle infrastructure is not perfect, and the management of bicycle traffic is also lacking. Therefore, improving bicycle infrastructure is an important part of developing green transportation. It is suggested that the relevant departments can learn from the excellent experience of foreign countries when constructing infrastructure, such as focusing on the construction and widening of bicycle lanes, constructing bicycle viaducts and bicycle parking lots, so as to improve the safety and convenience of cyclists.

4.3 The bicycle transportation standard system should be supplemented and improved

China's bicycle traffic development has been lack of due attention, now about the bicycle traffic development system needs to be further improved and supplemented. It is suggested that a bicycle development strategy in line with China's national conditions can be formulated from a practical point of view. At the same time, technological updates should be strengthened to improve the quality of the vehicle itself and further ensure the durability of bicycles and the safety of cyclists.

4.4 Strengthen the concept of green traffic travel

Using the new mode of "online + offline" to help the whole people use bicycles for transportation. It is suggested that the relevant departments should increase the publicity of green travel through the Internet and give bicycle subsidies to encourage more citizens to use bicycles to travel. We can emulate Denmark's concept of green transportation and comprehensively revive and promote the "bicycle culture". Offline, we can carry out nationwide bicycle race activities, implement the reward system to stimulate the boom of bicycle revival, and constantly strengthen the concept of green travel of citizens, so as to promote the sustainable development of bicycle transportation^[10].

5. Conclusion

In summary, with the accelerating speed of urban development in China, environmental pollution and traffic congestion are becoming more and more serious. It is of practical necessity and urgency to actively develop green transportation and encourage citizens to use bicycles to travel. In the process of the development of bicycle transportation in the future, it is necessary to strengthen the integrated development of bicycle transportation and public transportation, improve the construction and management of bicycle infrastructure, supplement and perfect the bicycle transportation standard system, and strengthen the traffic awareness of green travel of citizens. The development of bicycle traffic, reduce environmental pollution, so as to achieve green and sustainable development of the ecological cycle.

References

- [1] Pan Haixiao. *The evolution and sustainable Development of Urban Bicycle Transportation policy in China*[J]. *Urban Planning Forum*, 2011(04):82-86.
- [2] He Baohong, Li Yongchun, Li Xuefeng. *International. experience and Research status of bicycle traffic development in China*[J]. *Urban Planning International*, 2015, 30(05):104-109.
- [3] He Zhuoshu. *Foreign bike friendly facilities planning and design of research and practice*[J]. *Shanghai Urban Planning Review*, 2020(04):113-119.
- [4] Zhang Yan, Zhao Min. *The city public bike system work practice analysis and policy orientation*[J]. *Shanghai Urban Planning Review*, 2014(06):117-123.

- [5] Gössling S. *Urban transport transitions: Copenhagen, city of cyclists*[J]. *Journal of Transport Geography*, 2013, 33: 196-206.
- [6] Jiang Yang, Chen Yulin, Zhang Yuanling, Xie Jia. *Research on the revitalization and development strategy of urban bicycle Transportation in the context of motorization -- a case study of Copenhagen*[J]. *Modern Urban Research*, 2012, 27(09): 7-16.
- [7] Nilsson J H. *Urban bicycle tourism: Path dependencies and innovation in Greater Copenhagen*[J]. *Journal of Sustainable Tourism*, 2019, 27(11): 1648-1662.
- [8] Duan Ting, Ren Lijian, Yun Yingxia. *Optimization strategy of connection between greenway and rail transit: a case study of the connection between metro stations in guangzhou suburbs*[J]. *Modern Urban Research*, 2017(09): 92-98.
- [9] Li Binshan, Gu Xiaofeng, Chen Jianye. *Enlightenment of foreign bicycle traffic development strategy to Our country*[J]. *Transport Research*, 2020, 6(04): 69-75.
- [10] Wang Yue, Jiang Yang. *Study on the implementation Mechanism of Bicycle Transportation development in Copenhagen*[J]. *Beijing Planning Review*, 2018(01): 42-47.