

Overview of Bicycle Transportation in China

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As the most populous country in the world, China has relied heavily on bicycles for passenger transportation. The economic reform policy adopted in the late 1970s has brought dramatic economic growth during the last decade. Subsequently, bicycle ownership in urban areas increased from one bicycle for every three persons in 1980 to one bicycle for every two persons in 1990. An overview of bicycle transportation in China is presented. The advantages and disadvantages of bicycle transportation and its usage in China are discussed. It was found that the average bicycle travel distance is less than 4 km (2.5 mi). Bicycling is the transportation mode of choice for up to 70 percent of the urban passenger trips in China. However, because of its slowness, serious traffic problems occur when bicycle traffic mixes with motorized vehicle traffic. The mixing of faster and slower traffic modes causes a lower capacity and results in higher accident rates. In the average Chinese city, about 30 percent of the traffic fatalities are bicyclists. Traffic separation, better intersection control, and improved bicycle management are recommended to improve bicycle transportation in China.

The use of bicycle as a mode of transportation in China has a history of nearly 100 years. However, its usage began to take off in the late 1970s after the economic reform brought more disposable income to the Chinese people. Bicycle ownership in China more than quadrupled during the 1980s.

Chinese have relied heavily on bicycles for both urban and rural passenger transportation. Of all the registered bicycles, 40 percent were in urban areas as of 1982 with an average of one bicycle for every three persons. As a result of rapid economic growth during the 1980s, bicycle ownership increased to one bicycle for every two persons in 1990. Bicycles are playing a very important role in the transportation system of China. The purpose of this paper is to present an overview of bicycle transportation in China.

ADVANTAGES

Flexibility, economy, efficiency, and affordability are four major advantages contributing to the bicycle's popularity in China. The continuous development of China's bicycle traffic has clearly proved that it is the transportation mode of choice for many Chinese.

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Flexibility

The bicycle is more convenient than public transportation because of its private nature. When the travel distance is about 6 km or the travel time is less than 30 min, the bicycle is the more popular choice. Table 1 gives the average travel distance for bicycle traffic in 10 major Chinese cities.

Economy

Under ideal traffic flow, the average bicyclist will need 9 m² of road to operate, whereas an automobile needs 46 m². In addition, the average bicycle parking space is only 1.6 m², compared with 22 m² required for the automobile. A bicycle can easily operate in narrower lanes and requires relatively lower pavement strength.

Many Chinese cities have old districts, which are generally located in the central business districts. In many of these areas, 30 to 50 percent of the roads are narrow, ranging from 3.5 to 6 m in width. Public transit cannot operate in these narrow streets and back alleys. This kind of city structure gives a strong incentive to the development of bicycle traffic. For a nation of more than 1 billion people, the use of bicycles clearly reduces the pressure for more roads and parking lots.

Efficiency

Compared with other modes of transportation, such as the subway, bus, automobile, and so forth, bicycles consume the least amount of power and are pollution free and environmentally sound. If the travel distance is not more than 8 km, the average energy consumption of the bicycle is as little as one-ninth the power consumed by the motor vehicle, including power consumed in vehicle manufacture, trade, transport, maintenance, and operation as well as road construction. Bicycle traffic is free of both noise pollution and emissions. Developing bicycle traffic in urban areas is helpful in preserving the environment as well as saving energy.

Affordability

China, as a developing country, still has a long way to go in terms of developing its economy. With per capita income of U.S. \$500 per year, few people can afford to own an automobile. Consequently, bicycle is the logical choice for most

TABLE 1 Average Bicycle Travel Distances for 10 Major Chinese Cities

City	ATD(km)	City	ATD(km)	City	ATD(km)
Beijing	5.20	Wuhan	3.85	Zhengzhou	2.54
Shanghai	3.99	Guangzhou	3.84	Hangzhou	3.36
Tianjin	3.70	Chengdu	3.45		
Shenyang	3.40	Fushun	4.65		

Chinese. It is affordable; a bicycle costs the average citizen about 2 months' pay.

DISADVANTAGES

As most people know, bicycle transportation is not perfect due to its inability to accommodate longer travel distances, significant terrain changes, and varied weather conditions. The bicycle cannot be expected to travel long distances or operate in mountainous terrain. For example, in Chongqing, a city with steep terrain, the bicycle is used for only a small part of passenger transportation. In addition, it is difficult to operate in bad weather conditions.

As bicycle traffic increases, conflicts between bicycle and motor vehicle traffic also increase, and this results in a significant increase in traffic accidents. The bicycle is vulnerable to motor vehicles in this respect, so both the frequency and the death rate of bicycle accidents are at a high level. According to the statistics of 20 cities in 1981, there were 15,966 bicycle accidents, 32.1 percent of all accidents, with 798 people dead, 24.9 percent of all traffic accident fatalities. In Shanghai, 367 cyclists died in 1989; this is up to 56.3 percent of the traffic accident fatalities. From 1987 to 1990, 174 bicyclist died in Hangzhou, and the statistics of Xian showed that 41.8 percent of the traffic accident fatalities were bicyclists. In the average Chinese city, about 30 percent of the traffic fatalities are bicyclists.

IMPACT ON PUBLIC TRANSIT

With an improved economy and more disposable personal income, more and more Chinese commuters in urban areas are traveling by bicycle. As a result, public transit is gradually losing its ridership. In Beijing, 70 percent of the people traveled by bicycle in 1990 compared with 50 percent in 1986, and the percentage of people using public transit decreased from 50 percent to 30 percent.

This dramatic modal change in a short 4-year period is unheard of in the public transportation history of China. The recent urban origin-destination surveys show that in most cities, more people travel by bicycle than by public transit (see Table 2). With the increasing numbers of registered bicycles, this trend will continue.

In China, the urban transportation strategy is to give priority to the development of public transportation and to take full advantage of the bicycle as a short-distance trip vehicle and for walking substitution. Existing policies that pertain to bicycles are as follows:

- The bicycle is partially tax free.
- There are monthly traffic subsidies of 2 to 10 yuan for bicycle users.
- Bicycle manufacturing is increasing capacity to keep bicycle prices down.
- Bicycle parking is subsidized in most agencies.

TABLE 2 Percentages for Various Traffic Modes in 20 Chinese Cities

City	Year	Transit	Bicycle	Pedestrian	Private	Others
Beijing	1986	24.3	54.03	13.76	4.38	3.83
Shanghai	1986	36.11	24.23	36.26	2.34	1.06
Tianjin	1990	8.32	74.63	10.58	3.98	2.49
Nanjing	1986	19.2	44.10	33.10	2.50	1.10
Shijiazang	1986	5.0	58.65	33.35	NA	3.00
Guangzhou	1984	11.74	37.24	45.58	NA	1.11
Guiyang	1987	11.57	12.96	69.74	6.50	5.73
Zhengzhou	1987	3.23	63.05	32.95	NA	1.77
Dalian	1990	36.4	17.90	36.20	NA	3.00
Lanzhou	1984	22.57	29.30	45.01	NA	3.12
Shenyang	1985	10.10	58.65	29.00	NA	2.25
Fushun	1987	22.10	24.56	40.42	NA	13.01
Chengdu	1985	18.83	36.32	45.65	NA	3.20
Wuhan	1987	20.12	35.23	37.39	NA	7.26
Harebin	1985	17.70	28.48	39.41	NA	14.41
Changchun	1984	16.35	37.03	41.66	NA	4.96
Anshan	1987	9.31	54.04	33.74	NA	2.91
Hangzhou	1986	12.96	56.29	27.65	NA	3.10
Changsha	1983	25.19	31.39	39.21	NA	4.21
Zibe	1989	43.5	75.48	19.03	NA	0.60

It is clear that the existing policies in most Chinese cities encourage the development of bicycle transportation. In the foreseeable future, bicycles will continue to play a dominant role in the passenger transportation system of China. The Chinese have put a special touch on the bicycle and adapted it perfectly to their urban environment/highway design. Therefore, it is critical to coordinate the development of a bicycle-public transit transportation system to improve its overall efficiency.

MANAGEMENT OF BICYCLE TRAFFIC

In major Chinese cities, bicycle parking is well organized in the off-street parking lots around major bus or subway stations to facilitate traffic flow and minimize bicycle disturbance to motor vehicles. This was done to attract more bicycle users to transfer to public transit, and the results are encouraging.

Although public transportation has been improved significantly in the past decade, the poor accessibility, long waiting time, frequent delays, and crowded conditions make it impossible to meet the travel demands of daily commuters. This in turn pushes more people to bicycles. Therefore, it is clear that unless the mass transit system in China can improve its level of service, bicycles are going to remain a tough competitor in the future.

Chinese commuters would like to choose public transit for long trips, but a poorly planned transportation network forced them to consume too much time and energy. Some survey results show that people might prefer bicycling instead of walking to the public transit facility if the distance is more than 400 m. According to a survey of subway passengers in Beijing in 1990, about 30 percent travel to and from the subway station by bicycle.

When the bicycle and public transit work together, the result is a "pleasant" decrease in travel times for commuters, as indicated in Table 3. A recent study done in Beijing has shown that when the travel distance is within 4 km, the bicycle has obvious advantages. However, because of its slowness, serious traffic problems occur when bicycle traffic mixes with motorized vehicle traffic. The mixing of faster and slower traffic modes causes a lower capacity for both bicycles and motor vehicles and results in higher accident rates. To solve this problem, the following measures have been taken:

Separation

Bicycle traffic is segregated from motor vehicle traffic by raised pavement markers, guard rails, Jersey barriers, and separat-

ing strips. In some cities, the road network is constructed so that the bicycle is channeled by separating strips, which allows the bicycle to have absolute right-of-way.

Bicycle lanes also appeared in some cities. In Tianjin, for example, exclusive bicycle lanes have been adopted on streets that have high bicycle traffic volumes, and they prohibit cargo tricycles from operating during rush hours. In addition, at some bus stops, a separated midblock bus turnout is used to reduce the conflicts of bicycles with buses and pedestrians.

Intersection Control

The following traffic control measures are applied at intersections:

- Give priority to the bicycle at traffic circles.
- Create vehicle-prohibit zones.
- Set up a bicycle path/road.
- Limit left turns of arterial bicycles.
- Provide two- or three-level interchanges for bicycles and cars.
- Use channelization if the left-turn bicycle traffic is more than 15 percent.

Management

Since the bicycle is likely to continue its dominance in Chinese cities in the coming decade, a plan to manage bicycle traffic to improve its efficiency is critical for China. Bicycle management includes education of people, vehicle administration, and bicycle lane/road maintenance. It is recommended that a bicycle trust fund be set up by charging a nominal user fee/tax for bicycle manufacturing and registration. The money collected from this trust fund will be used exclusively to improve bicycle facilities in Chinese cities.

CONCLUSION

Bicycle has a unique role in China's passenger transportation system. It is the mode of choice for up to 70 percent of the urban passenger trips. In the foreseeable future, the bicycle will continue its dominance in most Chinese cities because of its flexibility, economy, efficiency, and affordability. There-

TABLE 3 Travel Times for Various Traffic Modes in Beijing, China

Traffic Modes	Trip Length (in kilometers)				
	2 km	4 km	6 km	8 km	10 km
	Travel Time in Minutes				
Bicycle	11.0	21.0	31.0	41.0	51.0
Bus (no transfer)	16.5	24.0 (21)	32.5 (34)	40.0 (34)	48.0 (40)
Bus (one transfer)	20.0	27.5 (24)	36.0 (32)	43.5 (37)	51.5 (44)
Subway(no transfer)	31.0 (22)	34.0 (25)	37.0 (28)	40.0 (31)	43.0 (34)
Subway(one transfer)		39.0 (30)	42.0 (33)	40.0 (36)	48.0 (39)

Note: The statistics in () are the times transfer procedure takes when using bicycle instead of walking.

fore, additional research to improve bicycle traffic flow in the urban environment is going to be one of the most important tasks for traffic engineers in China for the coming decade.

It is clear that the task of solving bicycle traffic problems in China cannot be undertaken by one agency alone. The cooperation and coordination of all transportation agencies

are required if China is going to have the most efficient and safe bicycle transportation system. It is essential that the city planning agencies, highway agencies, traffic management agencies, educational institutions, and bicycle manufacturers work together to keep bicycle transportation in China among the best in the world.