



Research Article

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## Investigating the development of Chinese rural roads

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### ABSTRACT

*In recent years, rural road construction plays the most important role in promoting rural development. Therefore, it is recommended by the government to make rural road construction as the primary means of promoting rural development. How to build rural road to promote rural development effectively became a major issue that transport departments faced. This paper presents some key findings about, considering limited financial resources available for rural road construction, what types of rural roads should be built, how they should be built, and what will be the impacts on rural development.*

**Key words:** Rural road; rural development; road planning

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### INTRODUCTION

China is a vast country, one of the largest by land mass, in addition to having the largest population in the world. The country has been in rapid development, with the gross domestic product (GDP) rising at an average annual growth rate of 15.7% from 1978 to 2012[1]. In conjunction with this growth, urbanization has been very significant in China. The amount of people living in rural areas declined from 790 million in 1978 to 642 million in 2012, while the population of China increased from 963 million to 1.35 billion and the proportion of people living in rural areas to total population decreased from 82.08% to 47.43%[1]. However, the rural population is still large and they own less farmland, 0.17 hectare per capita in 2008[1]. Unemployment is typical in countryside. With the present production mode of agriculture that agricultural production is mainly operated by individual households that each household works on about 0.5 hectare farmland [1], and that agricultural machinery, chemical fertilizers and pesticides are used generally in production, only one-eighth of rural dwellers engage in farming. Thus, over 500[1] million rural dwellers could migrate to cities looking for work; however, the cities cannot provide enough jobs. According to the Chinese government's calculation, if that many rural dwellers migrate to cities, it would cost RMB 42,000[1] billion to construct urban public infrastructure. This would be incredibly expensive so Chinese urbanization will need to be a gradual process, while the countryside also needs to continue to develop. Only in that way can China reasonably handle the relationship between city and countryside, as urbanization occurs [2]. In recent years, the Chinese government has invested a large sum of money in rural areas including areas such as transportation, education, health care, water supply, and tele-communications. Among all these projects, rural road construction plays the most important role in promoting rural development as we will explain in a typical example; rural road construction in Zhejiang Province of China achieved a good social and economic benefit. Therefore, it is recommended by the government to make rural road construction as the primary means of promoting rural development and making urbanization in China steady and gradual [3]. How to build rural road to promote rural development effectively became a major issue that transport departments faced. Since 2006, Chang'an University has been commissioned by the Ministry of Transportation of China to carry out several research programs. In these research efforts, a key question that we have faced is how rural roads can promote rural development. Considering limited financial resources available for rural road construction in China, we needed to examine what types of rural roads should be built, how they should be built, and what will be the impacts on rural development. This paper presents our key findings thus far.

The remainder of this paper is organized as follows. The next section presents the role of rural roads to promote rural development and an example of rural road development in Zhejiang Province of China is described as illustration. After that, we will analyze the current situation of Chinese rural roads and the future Chinese rural road demand. Finally, the study will be concluded with a few thoughts.

### THE ROLE OF RURAL ROADS TO PROMOTE RURAL DEVELOPMENT IN CHINA

Chinese highways provide the main transportation among cities, between cities and rural areas, and between China and other countries. According to “the Highway Act of China,” highways can be divided into four types by functions: national highway, provincial highway, county highway, and township road. In 2006, the Ministry of Transportation incorporated a fifth type, village road. The specific definition of each road type is presented as follows (see Figure 1).

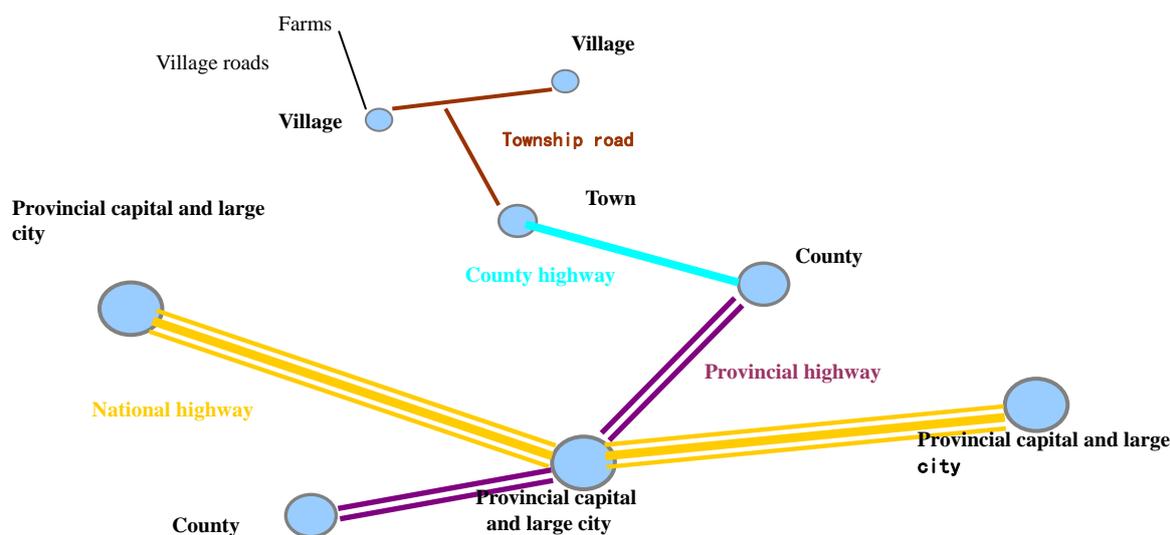


Fig. 1: Classification of Chinese road systems by function

National highways include international highways, national defense highways, highways that connect the national capital and provincial capitals, and highways that connect economic centers, hub ports, strategic points, etc. They are similar to the “interstate highways” in the U.S [4][5].

Provincial highways include highways that link key cities to main economic zones within a province and those highways that do not belong to national highways but connect provinces. They are similar to “highways” in the U.S.[4][5].

County highways include highways that link county capitals and commodity production and distribution centers, highways that link townships, and highways that do not belong to national highways and provincial highways but connect individual counties. They are similar to “county roads” in the U.S.[4][5].

Township roads include roads that connect townships and administrative villages, roads that connect individual administrative villages, and roads that do not belong to national highways, provincial highways and county highways but link townships to external regions. They are similar to “rural roads” in the U.S.[4][5].

Village roads include internal roads within administrative villages, and roads that do not belong to national highways, provincial highways, county highways, and township roads but connect administrative villages with other areas. They are also similar to “rural roads” in the U.S.[4][5].

Distinguished from American rural roads, Chinese rural roads are composed of county highways, township highways, and village roads.

From 2003 to 2012, China has invested RMB 1488.8[6] billion in rural road construction, with total distance of 3.68[6] million kilometers built by 2012. Rural roads in China certainly promote economic development and improve the standard of living of the rural population. From the view of economic development, firstly, rural road construction enhances the efficiency of agricultural production and increases rural population’s income. Rural roads can connect agricultural production bases with external road networks and consequently help rural areas with easier access to

regional gathering and distribution centers for goods and materials. One key benefit is that rural roads allow the agricultural mechanization to enter into farming land, which helps to improve production efficiency. Another key benefit is that agricultural goods, chemical fertilizers, and pesticides are transported conveniently and with reduced transportation costs; in addition, the damage of goods during transportation caused by bumpy roads is reduced [7]. Consequently, rural roads reduce agricultural production costs and increase agriculture income.

Furthermore, rural roads can help the development of rural businesses (i.e. industrial, commercial, and tourist)[8]. Rural roads can connect businesses and markets; they allow the convenient transportation of passengers, business materials, and goods at lower costs. From the view of improving the standard of living of rural dwellers, rural roads improve the accessibility of rural areas and makes travel of rural population convenient. They provide the possibility of increasing incomes by allowing people to access to employment opportunities. They also increase people's access to shopping, entertainment, medical care, and schooling while deepening the communication and interaction between cities and rural areas, which can promote the spread of culture and other positives of city life to rural areas [9][10].

Take rural road development in Zhejiang Province of China as an example. From 2003 to 2005, total capital investment in rural road construction was amounted to RMB 9.66 billion [9], while density of road network increased from 62.02 km/100 square kilometers in 2003 to 93.59 km/100 square kilometers in 2005 [9]. The investment in rural road construction to GDP of Zhejiang Province reached 0.48% [3]. Total output of agriculture in Zhejiang Province increased from RMB 110.2 billion in 2002 to RMB 133.2 billion in 2004 [3]. Commodity trading market and agricultural supply market were established in each township. Tourist attractions and operation of mineral resource recovery have been expanded in rural areas. Due to the improvement of rural transportation, vehicle transportation costs were reduced by RMB 13.3 million and the value of goods damage during transportation was decreased by RMB 802 million from 2003 to 2005 [3]. Rural road construction also increased the income of rural dwellers as it reached to RMB 37.4[3] billion in 2005. 35 million rural dwellers travel conveniently [3], the travel time to townships was reduced by 59% and to county capitals by 54% [3]. The time savings of passenger travel can be converted into economic benefits reaching up to RMB 593 million per year [3].

### PRESENT SITUATION OF CHINESE RURAL ROADS

The rural road network in China is like a tree-like network structure, which mainly connects capitals to townships, and then to villages. There are distinct disparities of accessibility and expedite<sup>1</sup> between townships and villages in the eastern, central, and western Chinese regions. Figure 2 indicates that, in general, townships and villages are accessible and expedite in the eastern region, townships are accessible and expedite and villages are accessible but not expedite in the central region, townships are accessible but not expedite and villages are neither accessible nor expedite in the western region.

The technical indicators of Chinese rural roads are low (Figure 3). The width of roadways is generally 3-3.5 meters. Rural roads lack necessary greening, safety facilities, and parking facilities. Turning radius and the carrying capacity of some roads cannot meet the requirements of heavy trucks; some roads have major damages after use only for 3-5 years [6].

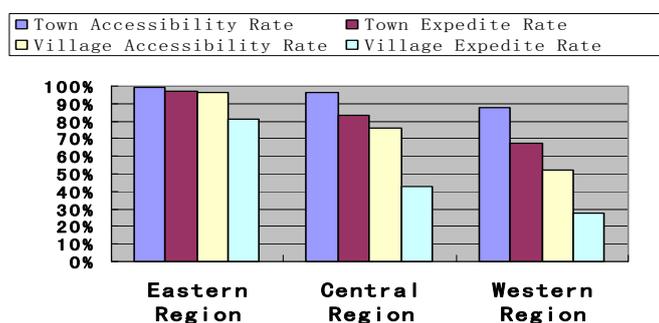


Fig. 2: The level of accessibility and expedite of chinese townships and villages in 2005  
Source: National bureau of statistics of china, road statistics (2005)

<sup>1</sup>The meaning of township accessibility is that rural roads connect township governments. The meaning of village accessibility is that rural roads connect committees, schools, nursing homes and public medical clinics of administrative villages. The meaning of township or village expedite is that the surface types of rural roads, which help achieve the accessibility of townships or villages under all-weather conditions, are asphalt concrete, cement concrete, or other harden pavement.

Medium-sized passenger buses are used by rural bus companies for passenger transportation (shown in Figure 4). As a result of low travel frequency of rural dwellers, the income of rural companies is poor, some towns and administrative villages are not served with passenger buses. In these cases, rural dwellers usually travel by motorcycle or tractor (shown in Figures 3 and 5). There are two types of vehicles used in rural areas to transport goods. One is heavy trucks to transport large quantities of goods. The other is three-wheel vehicles to transport small quantities of goods (shown in Figure 6).



**Fig. 3: Chinese rural road (Gansu province)**



**Fig. 4: Passenger travel by medium-size bus**



**Fig.5: Passenger travel by tractor**



Fig.6: Three-Wheel vehicle

## DEMAND ANALYSIS OF CHINESE RURAL ROADS AND KEY POINTS OF RURAL ROAD DEVELOPMENT IN THE FUTURE

### Demand analysis of Chinese rural roads

The United States has the most developed economy in the world. Its urbanization level was 81% [5] in 2012, while China, in a stage of rapid economic development, had an urbanization level of 47.43% in 2012 [1]. The experience of the United States during its process of urbanization can be of value to China's rural development.

First, in the U.S. urbanization process, some rural dwellers migrated into large and medium-sized cities with more than 100,000 in population [5]. Unemployment in China's countryside is significant; this results in low agricultural income and disparities in urban and rural income levels. Urban resident income per household is almost three times as much as that of rural residents between 2000 and 2012 [1]. Because of the high income in cities, a large number of rural dwellers go there for work; the number jumped to 260 million in 2012 [1]. That the migration to cities can raise the income of rural residents and narrow the income gap between urban and rural residents. This is certainly helpful for social harmony (as the Chinese government has been campaigning in the past several years) and accord with experience of international urbanization. By following the trend in developed countries, the migration of rural population to cities can be helped through better road systems. Rural roads should connect villages and townships with cities to make it easy for rural dwellers to have access to cities.

Second, according to the current mode of agricultural production in China, over 500 million rural dwellers should migrate from villages to cities. However, there are a limited number of jobs in cities and a limited housing and other public infrastructure. The current urban infrastructure in China cannot support the migration of all unemployed rural dwellers, so measures should be adopted to avoid that level of migration. An effective measure is that townships should be developed into small cities that have enough jobs to attract rural population. For this reason, promoting industrial development of townships is crucial. Rural roads should provide transportation logistic services that will allow industrial development in townships; this will allow the growth of these areas [9].

Townships that are within short distance to cities have an opportunity of carrying on urban industrial transformation and have potential for being developed into small cities. Therefore, rural roads should connect these townships to allow easy exchange of goods and easy access for workers. For townships far away from cities, they may still be developed into small cities according to its own characteristics [9]. There are major differences between various regions in China with respect to geographic conditions and levels of economic development; China is normally divided into eastern, central, and western region (shown in Figure 7). The eastern region gets help from public policy support and coastal geographic advantages. It has built manufacturing enterprises in its rural areas since China's economic reform to open itself up to outside world. However, the central and western regions lack these advantages and have poor transportation infrastructure, so the number of the rural manufacturing enterprises is few and economic development has fallen behind. Lack of water, mountainous geography may be the key reasons why fewer people lived in the west part of China. Furthermore, lack of national and provincial highways makes people there living in a isolated condition.



Fig. 7: Regional division of china

In the eastern region, rural manufacturing enterprises mainly are located in townships [9]. Rural roads connect townships with external road networks to allow convenient transportation of these enterprises' goods. The central and western regions attempt to attract enterprises that suit their own features, which are leading producers of agricultural commodities in China and have agricultural acreage that accounts for 37% and 38% of Chinese totals, respectively, in 2012 [1]. For this reason, the central and western regions have an advantage to build businesses that process goods from farms. In addition, the central and western regions have the majority of China's 45 types of minerals' reserves (accounting for 44.8% and 39.7% of China's totals, respectively [11]). To have a resource-focused economic development, the central and western region can build plants to process mineral resources. Furthermore, in the central and western region, the geography is diverse and the urbanization level is low. Plentiful natural and historic landscapes are near or in villages, so these areas can attract city residents for tourism. The rural dwellers can raise their income by providing food and beverage services and selling native and special products to tourists.

Therefore, in the central and western region, rural roads should guide manufacturing of farm produces and natural resources to settle in townships. On the other hand, rural roads should also guide rural tourism development into small cities[12]. For the townships near agricultural production bases, rural roads should connect them with agricultural production bases and external road networks. This will allow farm products to be transported from agricultural production bases to townships, and then enterprise products can be exported from townships to larger cities. Generally, farm produces and other products are transported by heavy trucks and may be damaged by bumpy road, so the width, turning radius, and the smoothness of roadways that connect townships with agricultural production bases and external road networks should be designed to handle the characteristics of heavy trucks. This will require roads to be the proper dimensions and have hardened pavement. For townships near mineral resources, rural roads should connect them to mines and external road networks for the same reasons as those near agricultural resource bases. Generally, mineral resources and their products are transported by heavy trucks, so the maximum longitudinal slope and the carrying capacity of sub grade and pavement of roadways should be able to handle heavy trucks with large payloads. For tourist attractions in rural areas, rural roads should provide access for tourists to visit them. Therefore, rural roads should connect tourist attractions with townships that are major gathering places for travelers. Parking facilities should be built in and near tourist attractions. Road connecting tourism attractions should use surface hardening methods and keep the natural beauty of the area for the enjoyment of tourists and protection of the area.

With rural dwellers migrating into cities and townships, rural population will decrease gradually, as already experienced in many Chinese rural areas, the villages with smaller population will face with the difficulty of providing rural community public services. With limited government financial resources, nearby villages could be combined together for providing better public services and for avoiding building of rural roads to villages with shrinking population. Furthermore, to guarantee rural road construction with limited fund available and to reduce unnecessary land consumption and environmental disturbance of rural road construction, villages with small population size (e.g., fewer than 1000) can be connected by simple paved roads.

Third, with the Chinese urbanization process and young and middle-aged rural dwellers migrating to cities, capital, technology and resources are also centralized in cities. Rural areas lack of labor and financial resources, and farmland is often abandoned in some regions [10]. The rural surplus population in other regions has also become a factor of social instability as these regions decline. In order to promote the steady process of urbanization in China,

urban and rural development should be coordinated.

From the view of promoting agricultural development, the migration of the rural dwellers will substantially reduce the population that has engaged in farming. The land per farmer will be increased to help mechanize agricultural production. Rural roads should be able to support large-scale agricultural machinery and support heavy trucks going in and out the agricultural land necessary for transporting farm goods and materials. Therefore, rural roads should connect agricultural land with townships that are regional distribution centers for goods and materials and with external road networks, so that these vehicles and machinery can enter and leave agricultural land easily. The road width and turning radius of rural roads should meet requirements of these vehicles' movement, and hardened pavement should be adopted to minimize the damage to products caused by bumpy roads.

Rural population decline is mainly due to the residents' low income and poor living conditions. Therefore, to avoid the decline in rural areas, rural population's income needs to be improved. Providing necessary transportation need can allow rural population to find job opportunities, and facilitate the mechanization of agricultural production. It is also necessary through rural road development to improve rural infrastructure for an improved living environment for the rural population to have access to work, shopping, school, medical care, and recreation. Rural businesses, entertainment, schools, and medical clinics are mainly concentrated in townships so rural roads should connect townships with villages. In accordance with the characteristics of passenger travel demand, rural roads should be built with both good and passenger transportation in mind.

#### **The key points of rural road development in the future**

Comparing the future rural transportation demand with the present situation of Chinese rural roads, the focus of Chinese rural road development in future is as follows:

(1) Connecting farmland with townships, the width and turning radius of rural roads should be designed for the characteristics of heavy trucks and hardened pavement should be adopted.

(2) In the eastern region, connecting villages of more than 1000 people with townships by hardened pavement roads; connecting villages of fewer than 1000 people with simple paved roads. In the central and western regions, connecting villages of more than 1000 people to townships and connecting townships to county capitals by hardened pavement. Connecting the villages of fewer than 1000 people by a simple paved road. Connecting the townships with nearby agricultural production bases; the width and turning radius of the roads should suit for the characteristics of heavy trucks and hardened pavement should be adopted. Connecting townships with nearby mining areas; the maximum longitudinal slope and the carrying capacity of sub grade and pavement of the roads should be designed for the characteristics of heavy-load vehicles. For tourist attractions in rural areas, rural roads should connect tourist attractions with townships and external road networks; parking facilities should be built in tourist attractions. Roads should be constructed with transportation of both good and people in mind. The connecting roads should adopt hardened pavement and with vista points along roads with attractions.

#### **CONCLUSION**

In the process of urbanization of China, rural roads could play an important role in making urbanization steadily. Rural roads should be built in conjunction with rural development to make travel of rural residents easy. Rural road development could also serve to promote concentration of population steadily and with environment and land conservation. Rural roads not only need to enhance accessibility to townships to make travel of rural residents convenient, but also need to provide transportation of goods for the development of agriculture, manufacturing, farm produces processing industry, mineral resources processing industry and rural tourism. Rural roads are indeed multi-functional. Furthermore, it is noted that there are different rural economic development factors (i.e. agricultural, industrial, commercial, and tourism) for different regions, rural roads should be built according to characteristics of different regions to promote development of different regions effectively. With this principle, building of rural roads with ineffective functions to rural development can be avoided, excessive, expensive high construction standards for rural roads can be prevented, and the formance of limited financial resources for rural road construction can be assured. In particular, technical indicators of rural roads should not be chosen according to high standards blindly, but according to the characteristic of rural transportation characteristics. Safety facilities, parking facilities, waiting facilities and vehicle maintenance facilities should be constructed with rural roads simultaneously to make passenger and goods transportation safe and convenient.

For constructing a harmonious society and with the trend of continuous government revenue increase, the central government and provincial governments should play a greater role in rural road development and continue to increase investment in rural roads. To improve the operational performance of rural passenger transportation, the

business model of joint investment by the governments and private industry, which should be oriented for public welfare, could be adopted to correct the current situation of over-reliance on market and lack of investment by governments. For the operating loss of rural passenger transportation caused by providing accessibility for rural dwellers, appropriate subsidy policies could be designed.

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#### REFERENCES

- [1] Road statistics. *National Bureau of statics of China*, Beijing, China, **2013**.
- [2] G.E.Guldin. Farewell to Peasant China: Rural Urbanization and Social Change in the Late Twentieth Century. Armonk:M.E.Sharpe, Inc, **1997**.
- [3] Wang Yuanqing, Ma Shuhong. The evaluation of “Village Project” effects and results in ZheJiang Province. Xi’an, China, **2007**.
- [4] FHWA. Our national highway.USA,**2000**.
- [5] FHWA. Highway Statistics 1996-2007. Washington D.C., Government Printing Office 1997-2007.
- [6] Rural-road statistics. The ministry of transport, Department of Rural-road, Beijing, China.
- [7] Lin S,S Shunfeng.Urban Economic Growth in China:Theory and Evidence.*Urban Studies*, v.39, n.12, pp.2251-2266,Oct.,**2002**.
- [8] LiWen. The construction and poverty reduction of Rural road . China Financial and Economic Publish House. Beijing, China, **2006**.
- [9] Wang Yuanqing. The planning of rural-road serves the construction of new rural. Xi’an, China, **2008**.
- [10] Wang Yuanqing. Rural transport Construction and social change in China. Xi’an, China, **2009**.
- [11] Wang Yongwei. Distribution and long-term forecast of mineral resources in China. Shan’xi, China,**2007**.
- [12] Ma Shuhong,Zhou Wei, The coordinated development of the rural road system research. *Chinese and foreign highway*, v.7,n.6, pp.205-207,June, **2007**.