Research on World Agricultural Economy
https://journals.nasspublishing.com/index.php/rwae

ARTICLE

Rural Roads and Poverty Alleviation: Evidence from China

Di Yang

YanShan College, Shandong University of Finance and Economics, Jinan 271199, China

ABSTRACT

There are still no developed roads in the places where a large part of the world's people live. Due to the lack of roads connecting them to the outside world, their transportation costs are high and their livelihoods cannot be improved. Poor infrastructure development has been proven to cause poverty and isolation, while also leaving local people with very few opportunities for survival choices. This paper aims to systematically analyze the impact of rural road construction on poverty reduction, with a focus on the mechanisms and channels involved. Using a comprehensive dataset from 205 prefecture level cities in China between 2011 and 2019, I derived an empirical regression analysis model based on the assumption that the individual utility function is a constant relative risk avoidance utility function, and introduced fixed effects to evaluate the poverty alleviation effect of rural roads. The construction of rural roads can not only promote the increase of household consumption and the production of fresh agricultural products, but also encourage rural residents to switch from agriculture to other professions, thereby increasing their income. At the same time, my regression results indicate that rural residents receive more social benefits. Therefore, our findings provide evidence for the necessity of getting through the "last mile" in remote areas of developing countries.

Keywords: Rural Road; Poverty Alleviation; Rural Development; Farmers' Lives

*CORRESPONDING AUTHOR:
Di Yang, YanShan College, Shandong University of Finance and Economics, Jinan 271199, China; Email: yd202310@163.com

ARTICLE INFO
Received: 29 December 2024 | Revised: 1 March 2025 | Accepted: 4 March 2025 | Published Online: 30 April 2025
DOI: https://doi.org/10.36956/rwae.v6i2.1592

CITATION
Yang, D., 2025. Rural Roads and Poverty Alleviation: Evidence from China, Research on World Agricultural Economy. 6(2): 485–498.
DOI: https://doi.org/10.36956/rwae.v6i2.1592

1. Introduction

Currently, many developing countries still face the test of poverty and are seeking a way out of the development dilemma. Rural transportation remains one of the bottlenecks restricting economic and social development [1, 2]. Governments have attempted to address this problem by investing heavily in the construction of railroads and roads. For example, the large-scale rural road construction project (URRAP) in Ethiopia has expanded road density by 2.26 times from 2010 to 2015, increasing the opportunities for villages to obtain products and enter the market; at the same time, Ethiopia has experienced accelerated inclusive economic growth, and the country's poverty level has fallen from 44% to 30% [3]. Due to poor road connectivity in India, it hinders the accelerated development of rural areas, so the Prime Minister's Rural Roads Project was started in 2000 to build and upgrade regional, farm-to-market all-weather roads for villagers and connect them to educational institutions, schools, and hospitals, benefiting 185,000 villages [4, 5]. China has similarly taken the initiative to build roads in rural areas. In 2023, the total mileage of rural roads will reach 4.6 million km, effectively solving the problem of ring road access to established villages and natural villages, and providing better travel security for the peasant population.

Existing research largely supports the claim of policy makers. Rural infrastructure construction is an important measure of rural development. Specifically, rural road construction has a strong positive correlation with agricultural and non-agricultural economic development and poverty alleviation [6, 7]. But little has been written to specifically measure the impact of rural construction on the livelihoods of rural people in China. In order to measure the impact of rural road construction on the livelihoods of local people, this paper used the local government statistics on the livelihoods of rural residents from provincial and municipal statistical yearbooks and the China Rural Statistical Yearbook, while data on rural road construction were obtained from the China Transport Statistical Yearbook and publicly available data from the Chinese Ministry of Transport.

This paper analyses five main outcomes of the impact of rural road construction on rural households: agricultural production, career election, income, consumption, and social welfare. The first main result is that in areas with more densely built roads, production of fresh produce increased due to increased transport efficiency and reduced transport costs. Secondly, I find that rural roads led to a significant redistribution of labor away from agriculture, with farmers moving away from their original agricultural land and into employment in transport, manufacturing and construction. Thirdly, there is some supportive evidence that rural road construction can indeed reduce poverty in rural areas. The construction of rural roads has significantly increased the income levels of rural residents and to some extent narrowed the urban-rural income gap. In the meantime, the construction of rural roads has also significantly contributed to the increase in consumption levels of rural residents and the transformation of household consumption structure. Finally, the provision of subsequent social services by the government has also increased after the completion of rural roads. In short, this paper shows that there is a positive and beneficial relationship between rural roads and poverty alleviation, which will significantly improve the lives of rural residents and promote rural areas to enter a new era.

The rest of this article is written as follows. The second part introduces the development process of rural roads in China and the viewpoints of other scholars on rural infrastructure and poverty reduction. A theoretical framework on how rural roads affect the activities of local residents has been established in the third section. The fourth section describes data and empirical strategies. The fifth section presents the results and discussion. The research findings of this paper are discussed in the final section.

2. Literature Review

2.1. The Role and Impact of Road Infrastructure on Poverty Alleviation

The construction of transportation infrastructure can spur economic growth by employment generation [8, 9] ensuring that domestic enterprises improve productivity [10], reducing transaction costs [11], optimizing factor allocation [12], and bringing lasting impact on

economic development [13, 14]. Some scholars also found that transportation infrastructure will have a slight and negative impact on GDP [15, 16].

Most of the above research on transportation infrastructure focuses on classified highways (including expressways), railways and high-speed railways, while the research on rural roads is very limited. Many scholars have found that rural transportation infrastructure can increase employment and increase the income of non-agricultural enterprises [17], promote the formation of the national market [18], and bring long-term returns to human capital [19]. Yogita Shamdasani shows that the development of rural roads has promoted crop diversification and commercialization of agricultural output [5]. Aggarwal studied the impact of rural roads on access to and use of health care from the perspective of public services, proving that the impact of roads on economic activities is almost everywhere [4]. However, Asher and Novosad found in their research on the Prime Minister's Village Road Program that rural roads will enable large numbers of agricultural laborers in rural area to go out to work and enter the urban labor market for employment, but they fail to find that rural roads have a significant positive impact on the local economy, and agricultural production has not changed significantly [20]. Domestic research on rural roads and rural infrastructure focuses on its poverty reduction effect. Gao et al systematically analyze the coupling and coordinated development between the digital economy and total factor productivity in China's agricultural sector. However, there is little research on rural roads and residents' lives [21].

2.2. The Construction Status of Rural Roads in China

In 2003, the transportation department pointed out the future direction of work, which was to build rural roads and enable rural residents to travel on hardened roads paved with cement, further promoting urbanization development, made major adjustments to the investment structure, increasing investment in rural roads, and organized the implementation of access and smoothness projects to improve the traffic conditions of rural roads.

In 2004, "strengthening rural infrastructure construction" was placed at the top of the national government's work documents to create conditions for increasing farmers' income.

At the beginning of 2005, the State Council approved the rural road construction plan. The transportation department and the National Development and Reform Commission have arranged for the central government to invest 100 billion yuan over five years to ensure the smooth and successful construction of rural roads.

In 2006, the Ministry of Communications and the National Development and Reform Commission jointly arranged a central investment of 40 billion yuan to build the "access project".

In five years, the central government has invested 1978 billion yuan in rural highway construction. The central investment, which grows by 30% annually, greatly stimulates local investment in rural road construction. In the next five years, the whole society has completed a total investment of 950 billion yuan, 1.868 million kilometers of rural roads have been newly built, and there are 527,000 kilometers of newly built rural roads, and the total length of rural roads has reached 3.45 million kilometers.

In 2012, with an investment of 214.502 billion yuan, the mileage of rural roads increased by 114,400 kilometers compared to the end of the previous year, including 195,000 kilometers of rural road reconstruction.

In 2014, the General Secretary made an important instruction on the construction of rural roads, stressing that "rural roads should be properly constructed, managed, maintained, and operated well", and the traffic bottlenecks restricting rural development should be gradually eliminated, so rural roads can help most farmers escape poverty and provide better guarantees for moving towards a prosperous society.

From **Figure 1**, we can see the development of rural roads in China from 2003 to 2023. In the past two decades, China's "four good rural roads" have triggered great changes in rural areas, and solved the problem of hardening roads in 1040 towns and 105,000 organic villages, from 2011 to 2023, the total length of rural roads increased from 3.564 million kilometers to 4.6 million

kilometers. The tremendous development achieved by rural roads in the past twelve years.

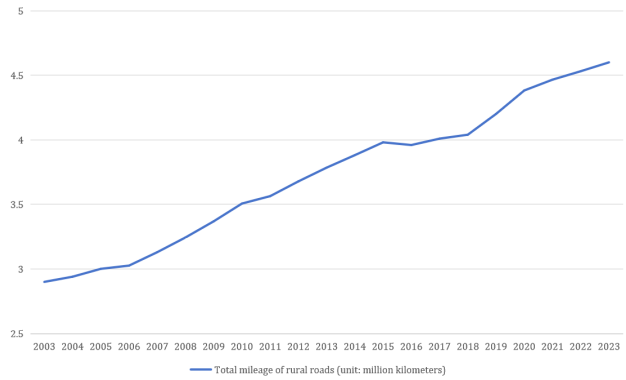

Figure 1. Total mileage of rural roads (unit: million kilometers).

The State Council Information Office presented a guiding document in 2024 on how rural roads can be developed in today's China, which states that China has embarked on a path of rural road development that is in line with its national conditions, and has also contributed Chinese wisdom and solutions to the global poverty reduction cause [22].

2.3. The Impact of Rural Roads on the Lives of Rural Residents

In this section, a brief explanation to understand the impact of building rural roads on rural life is provided.

Due to geographical isolation and lack of road access, rural labor is restricted from entering the job market, while also hindering farmers from expanding their agricultural market. Furthermore, this situation reduces their opportunities to increase income [23]. Many residents living in impoverished rural areas are unable to have opportunities for economic development and employment due to their isolated living locations, poor road conditions, and inadequate infrastructure services. This situation makes it difficult for people to reach their workplaces, and related living service locations, transport goods to markets, and send children to school. It is obvious that the construction and maintenance of rural roads cannot be separated from people, which can also provide additional employment opportunities. After the completion of rural road construction, the transportation costs between the village and the external market will decrease, which will bring the prices and wages of the village closer to those of the outside world. At the same time, rural roads have also built bridges for smooth communication between local and external information, enabling rural residents to access basic services, expand family mobility, and increase their opportunities to interact with the outside world. Literature from Bryceson et al. [24] and Faiz [25] have recognized that roads can play an important role as poverty reduction strategies in rural areas.

In order to examine the lives of villagers in more detail, this paper explores the impact of consumption, agricultural production, and income, as well as education and health care. Consumption can represent how many quantities and types of goods a family uses to meet their daily necessity, therefore consumption more comprehensively reflects the actual situation of family life. Rural residents living on vast land have relied on the output of this land for thousands of years to sustain their livelihoods. With the continuous evolution of human society and the continuous improvement of transportation infrastructure, rural residents' employment is no longer limited to that rural land, and they can choose to enter urban employment. It is obvious that rural residents who grow grain and fruit should have different incomes. Similarly, rural residents who choose to engage in the primary industry and the secondary industry should also have different incomes. It cannot be ignored that education and healthcare, as potential benefits for residents, will also be more easily accessible to rural residents due to the smooth roads. Therefore, this paper has chosen these five aspects to comprehensively measure the living conditions of rural residents. Based on existing research and the reasons for government decision-makers to construct rural roads, this paper has identified the relevant impact mechanisms.

(1) Consumption. The significant increase in household consumption expenditure highlights the economic resilience and improvement of living standards in this region [26]. When rural roads are connected, industrial and everyday consumer goods in cities are more easily sold to rural areas [27], thus releasing the consumption potential of rural residents by increasing the supply of

products. Aggarwal found that after rural roads are connected, the reduction in transport costs leads to a large number of out-of-town influx of urban goods into the countryside and a significant reduction in their selling prices, which in turn leads to a significant increase in household consumption in areas such as perishable and processed foods (out-of-town goods) and an improving quality and structure of consumption [28].

(2) Agricultural production. After the smooth flow of information channels, farmers' timely awareness of agricultural product trading information can be improved, which can promote the adjustment of agricultural land scale [29]. I first consider agricultural production. Different farmers have their own preferences when facing different crops, so they also choose crops based on their own needs and preferences when planting. This preference may lead to incomplete utilization of land resources, resulting in a decline in agricultural productivity. But as the construction of new rural roads approaches the market and the degree of market integration increases, this situation will improve significantly [30]. After the prices of input raw materials such as fertilizers and seeds decrease, farmers will be more inclined to use these low-priced raw materials, thereby increasing agricultural production. Gebresilasse shows that after the improvement of Ethiopia's rural road network, farmers will join a larger consumer market, and agricultural productivity can also increase with more opportunities for promotion and other public services [31].

(3) Career Selection. Rural road construction has also achieved the goal of digging deeper into jobs, expanding employment capacity, and guiding the rural masses to employment at home by strengthening skills training for rural workers, absorbing the masses to participate in construction near them, encouraging the masses to contract maintenance, and developing public welfare jobs for road maintenance and road protection. Asher and Novosad also demonstrate that rural roads can lead to a large number of agricultural laborers going out to work and entering the urban labor market for employment [20]. This career selection will also affect the next generation's career choices [32].

(4) Income. Originating from mainstream economics, when it comes to poverty reduction, established research advocates for increasing income and income mobility [33]. Rural residents living in remote areas without road connectivity do not have many opportunities to choose their own employment methods and economic conditions. But relying on rural road construction, they can engage in the construction and maintenance of rural roads, which increases their income. After the completion of rural road construction, physical barriers to external communication are broken, allowing rural residents to move to larger cities for employment and expanding the sales market for agricultural products. Therefore, rural residents have more opportunities to obtain living security, and their income can also increase [34]. At the same time, rural residents who focus on agricultural production receive a higher price for selling outside the village than they otherwise would [20]; some farmers also receive a higher wage price due to a shift in the type of work and access to employment in local rural road construction, so that rural road construction also increases the income of rural residents. Increased access to external labor markets for rural workers may increase the income of rural residents from outside employment.

(5) Social welfare. The development of transportation infrastructure such as rural roads also facilitates the government to provide social welfare such as education and healthcare for rural areas. In areas where rural road construction is more developed, local residents have a higher level of education, so they will have higher work experience and salary growth than workers with lower education levels [35]. If the road conditions are poor and difficult to access, people will not be able to quickly obtain rescue from other places when an emergency medical event occurs. In addition, some preventive healthcare drugs and hygiene products provided by other hospitals cannot be quickly delivered to the area [36]. Aggarwal found that the positive role of rural road construction in healthcare is prominent, such as facilitating pregnant women to go to medical institutions for prenatal check-ups and delivery, providing better healthcare for others, and improving vaccination coverage in the region [4]. The improvement of accessibility to healthcare services helps to enhance people's health status, thereby increasing their sense of happiness in life [37].

3. Data and Empirical Strategies

3.1. Data

I constructed a panel dataset of prefecture-level municipalities, combining data on rural road construction with municipal-level characteristics such as rural living conditions. I selected data from 205 municipalities in China from 2010 to 2019 to form the panel set. The main sources are data from the China Statistical Yearbook, China Transport Statistical Yearbook, China Rural Statistical Yearbook and the statistical yearbooks of provinces and municipalities from 2010 to 2019.

The data on agricultural production that I explored came from the China Rural Statistical Yearbook, which provides the area under grain crops, fruit and vegetable crops. Data on career selection, income, consumption, government public services and other control variables were sourced from the China Statistical Yearbook; where the China Statistical Yearbook did not complete the disclosure of all prefecture-level city data, I returned to the statistical yearbook for that prefecture. To mention here, regarding the income results, I not only studied the per capita disposable income of rural residents, I also obtained the income gap between urban and rural areas based on the calculation of the Thiel Index. In addition to examining the level of household consumption expenditure, I have also measured the structure of household consumption, which was defined as the proportion of per capita consumption expenditure, net of food expenditure, that accounts for total consumption expenditure.

The data on rural road construction mentioned in this article comes from the China Traffic Statistics Yearbook. According to the tasks, functions and traffic volumes that roads are used to accommodate, China classifies roads into five classes: expressway, first-class highway, second-class highway, third-class highway and fourth-class highway. In this paper, the mileage of Class III and Class IV roads are added together to obtain the mileage of rural roads. The definition of road network density (road), which is the ratio of the road length of rural roads to the administrative area of the province, is then used to measure the construction of rural roads. The descriptive statistics of the data are detailed in **Table 1**.

Table 1. Descriptive statistical analysis.

	Variable Name	Obs	Mean	Std	Min	Max
Dependent variables	Road (density)	2037	0.794	0.400	-	2.003
	Road (length)	1979	8.881	0.677	5.439	10.238
Control variables	Government expenditure	2025	0.765	0.026	-	2.003
	Population size	1221	5.953	0.798	1.609	7.882
	Industrial proportion	2047	0.790	0.278	-	1.000
	Years of education	2047	0.185	0.037	0.018	0.356
Independent variables	Consumption level	1908	8.993	0.465	7.611	10.229
	Consumption structure	1908	0.813	0.208	0.382	1.000
	grain yield	1591	4.875	0.929	1.356	6.678
	quantity of meat	1353	3.114	0.867	0.122	6.447
	Fruit production	1221	3.475	1.356	-	6.285
	Vegetable yield	1222	5.045	0.916	2.175	7.084
	Agriculture employment	1215	0.454	0	0.566	4.63
	Transportation employment	1215	2.165	0.09	5.089	60.23
	Manufacturing employment	1215	17.382	0.06	23.297	219.43
	Construction employment	1215	8.322	0.04	12.847	134.98
	Disposable income of rural residents	1209	8.994	0.397	7.743	10.016
	Urban-rural income gap	1019	0.102	0.058	-	0.283
	Number of hospitals	1213	5.110	1.232	-	4.585
	Number of hospital beds	1213	0.311	0.697	0.175	3.855
	high-school student	1010	2.350	0.583	3.045	7.508
	college student	1198	1.131	0.643	-	2.448

3.2. Empirical Strategies

The perspective of consumption calculation can better reflect the real life of rural residents in China. Therefore, this section provides a brief derivation model using the impact of rural road construction on rural residents as an example.

Based on Collie's research [38], the individual utility function is a constant relative risk aversion utility function (CRRA):

$$U(C) = \frac{C^{1-\theta}}{1-\theta} \tag{1}$$

Where θ > 0, U′ > 0, U″ < 0. The substitution elasticity of consumption remains constant between any two time points t, t + 1, and is equal to 1/θ. The marginal utility elasticity of consumption U″/U ′ = −θ is a constant.

And assuming that social demand is solely composed of individual and government expenditures, and that government expenditures are used for road construction (Road) and government purchases (G_m), then the total consumption for period t is:

$$C_t^* = C_t G_t^{\omega}, 0 < \omega < 1 \tag{2}$$

Where C_t and G_t respectively represent private consumption and government expenditure, G_t = Road + G_m, ω is the ratio between private consumption and government expenditure.

Assuming that consumers provide 1 unit of labor in each period without elasticity, their objective function is to maximize the expected value of lifetime utility:

$$MaxE_t[\sum_{i=0}^{\infty} \beta^t U(C_{t+i}^*)] \tag{3}$$

$$s.t. A_t = A_{t-1}(1+r) + Y_t - C_t - G_t \tag{4}$$

Among them, Y_t represents the income of period t, A_t represents the actual financial assets at the end of period t, A_{t-1} represents the actual financial assets at the end of period t−1, r represents the actual interest rate, β is the discount factor, and E_t is the expectation for the future based on all information from period t. Construct the Lagrange function as follows:

$$\begin{aligned} L = E_0[\sum_{t=1}^{\infty} \beta^t U(C_t^*)] \\ +\lambda_t[A_t - (1+r)A_{t-1} - Y_t + C_t + G_t] \end{aligned} \tag{5}$$

The first-order condition is:

$$\frac{\partial U_t}{\partial C_t} = \frac{\partial U_t}{\partial G_t} = -\lambda_t,\ E_0[\beta(1+\mathrm{r})\lambda_{t+1}] = \lambda_t \tag{6}$$

Learn:

$$\begin{aligned} \frac{\partial U_t}{\partial C_t} = \frac{\partial U(C_t^*)}{\partial C_t^*}\frac{\partial C_t^*}{\partial C_t}, \frac{\partial U_t}{\partial Road_t} \\ \frac{\partial U(C_t^*)}{\partial C_t^*}\frac{\partial C_t^*}{\partial G_t}\frac{\partial G_t}{\partial Road_t} \end{aligned} \tag{7}$$

So deduce:

$$C_t^{-\theta} Road_t^{\omega(1-\theta)} = \beta(1+r) C_{t+1}^{-\theta} Road_{t+1}^{\omega(1-\theta)} \tag{8}$$

Took the logarithm of both sides of the equation and organized it into:

$$\begin{aligned} \ln C_{t+1} - \ln C_t = \tfrac{1}{\theta}\ln\beta(1+r) + \\ \tfrac{\omega(1-\theta)}{\theta}(\ln ROAD_{t+1} - \ln ROAD_t) \end{aligned} \tag{9}$$

Write it as an econometric model:

$$\Delta \ln C_t = \alpha_0 + \alpha_1 \Delta \ln Road_t + \xi_t \tag{10}$$

Regression analysis is a suitable econometric method for determining the strength of the influence of independent variables on the dependent variable [39]. The effectiveness of fixed effects in promoting bidirectional interaction between transportation supply and demand has been confirmed [40]. This paper extended formula (10) to city i in year t and used the fixed effects model to conduct regression analysis, so there are:

$$PA_{i,t} = \alpha + \beta Road_{i,t} + \lambda Z_{i,t} + v_i + u_t + \xi_{i,t} \tag{11}$$

In formula (11), PA_{it} is the outcome variable of interest to us, and $Road_{it}$ is the core explanatory variable, which is the density of rural roads. Z_{it} is a series of control variables; V_i is individual effect; U_t is a fixed effect of time, excluding the influence of time trend; ξ_t is a random disturbance term.

4. Empirical Results

4.1. Consumption

Consumption, as an important representative indicator of poverty reduction, cannot be ignored, and I have chosen to measure the level and structure of rural per capita consumption expenditure. Columns (1)

and (2) of **Table 2** show that the construction of rural roads significantly increases the level of consumption expenditure of rural residents; columns (3) and (4) also indicate that the construction of rural roads also has a good contribution to the upgrading and transformation of the consumption structure of rural residents. This is in line with Aggarwal, who found that the variety of perishable and processed food items consumed by households increased after rural road linkages, which led to an increase in household consumption expenditure [28].

Table 2. Impact on consumption.

	Consumption Level		Consumption Structure	
	(1)	(2)	(3)	(4)
road	1.207***	0.554***	0.580***	0.222***
	(28.24)	(10.58)	(21.85)	(5.05)
Controls	No	Yes	No	Yes
Observations	2898	1175	1898	1175
R^2	0.3201	0.546	0.220	0.311

Note: *, * *, * * * respectively represent significant at 10%, 5% and 1% levels.

4.2. Agricultural Production

Table 3 presents information on the impact of rural road construction on agricultural production (food, meat, fruit and vegetables) as measured by logging the annual production of crops in tonnes. According to the regression results, the regression coefficients of rural road construction on the production of meat and vegetables are significantly positive. Meat and vegetables are also the first products to experience a reduction in transport costs and the easiest to transport in the cold chain. The construction of rural roads helps to save time in the transportation and storage of agricultural products and reduces the loss of fresh produce due to shelf life and from collisions, thus increasing production at source.

The impact on food grain production is too weak to be almost negligible, and Gebresilasse points out that when farmers have more professional knowledge, cheaper access to inputs, and richer market information, road construction can bring opportunities for farmers to utilize new resources and have a beneficial impact on local residents [31]. Therefore rural road construction should be intertwined with profitability-soil amendments need to be applied continuously if it is to increase agricultural productivity [41]. Although in isolation, rural roads have a significant positive effect on fruit yields; when other control variables are included, the effect of rural road construction on fruit yields is no longer significant.

Table 3. Impact on agricultural production.

	Grain Yield		Quantity of Meat		Fruit Production		Vegetable Yield	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
road	0.001	0.0613*	0.123**	0.224***	0.235**	−0.116	0.372***	0.306***
	(0.03)	(2.33)	(2.89)	(5.17)	(2.65)	(−0.94)	(11.04)	(7.18)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1591	1116	1353	1014	1221	981	1222	1012
R^2	-	0.032	0.007	0.100	0.007	0.035	0.107	0.166

4.3. Career Selection

Table 4 presents the impact of the new roads on career selections, an area where roads appear to significantly change economic behavior. This paper has selected agricultural workers, transport workers, manufacturing workers and construction workers to examine. From the first column of **Table 3**, it appears that new rural roads do result in fewer people working in agriculture. Combined with columns 3 and 4, the promotion of "food for work" in the construction and maintenance of rural roads has increased the number of people employed in the transport sector by absorbing farmers into local employment and increasing their income. The construction of rural roads has also reduced barriers to rural labor mobility, thus facilitating rural residents to leave

agriculture for labour-intensive industries such as manufacturing or construction.

Table 4. Impact on career selection.

	Agriculture Employment		Transportation Employment		Manufacturing Employment		Construction Employment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
road	−0.174***	−0.0433	0.362***	0.345***	0.338***	0.408***	0.649***	0.618***
	(−4.37)	(−0.65)	(9.04)	(4.58)	(8.36)	(5.93)	(11.21)	(5.28)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	2037	1215	2036	1215	2036	1215	2036	1215
R^2	0.010	0.049	0.043	0.222	0.037	0.268	0.064	0.218

4.4. Income

The impact of rural road construction on rural residents' disposable income per capita was examined. The impact on rural disposable income per capita and the rural-urban income gap is presented in **Table 5**. Due to the remote location, poor road infrastructure, and inability of the government to provide basic services, local residents are unable to establish good connections with the outside society. They are unable to have abundant network resources and financial assets, nor can they live a fulfilling life [42]. However, when rural road construction is improved, it can provide local residents with opportunities to reduce poverty by saving commuting or travel time. The government and enterprises also increase opportunities to provide basic services, and local residents have the right to choose more diverse employment methods and higher incomes [23]. As shown in columns (1) and (2) of **Table 5**, rural road construction has raised the disposable income of rural residents to a large extent. Also, rural roads play a significant moderating role in reducing the urban-rural income gap; although the values of their regression coefficients are small, when combined with the urban-rural income gap, the reality of the role of rural roads cannot be ignored.

Table 5. Impact on income.

	Income		Gap	
	(1)	(2)	(3)	(4)
road	0.817***	0.350***	−0.044***	−0.021***
	(22.26)	(8.55)	(−14.98)	(−3.79)
Controls	No	Yes	No	Yes
Observations	2027	1209	2027	1019
R^2	0.214	0.546	0.110	0.185

4.5. Social Welfare

Table 6 presents the social welfare refers to access to health care and education. This paper used the number of hospital clinics and the number of beds in hospitals to measure local rural residents' access to healthcare; and the number of students enrolled in high school and the number of students enrolled in university to explore whether rural residents would choose to continue their education, as compulsory education in China stops at junior high school. The road construction in India has brought greater benefits to local women, such as more institutional prenatal checkups and the choice to go to professional medical institutions for childbirth, as well as better healthcare and higher vaccination coverage [4]. Correspondingly in China, the results in columns (2) and (4), after including all control variables, show that the construction of rural roads increased the number of hospital clinics and the number of beds provided, and that rural residents had better access to health services than before.

Next is the implications for continuing education. For individuals, a key trade-off is between obtaining long-term human capital investment through education and the direct economic opportunity of immediate employment. Educational achievement should be encouraged if links to new markets increase the returns to education or otherwise enhance household income or mo-

bility. However, the opportunity for immediate income for young people may drive them to drop out of school early [43]. This is also true in China, where road construction has the smallest statistically insignificant impact on high school enrolment.

Galor believes that agricultural landowners in any country hope that labor can choose immediate employment, because if labor chooses to receive education, then the wages that should be paid to them should naturally increase. Agricultural landowners certainly hope to pay lower wages, so they have the motivation to undermine long-term investments in human capital in education. Increased access to low-skilled labor market opportunities in remote rural areas may reduce investment in human capital [44]. Adukia et al. also demonstrate that children stay in school longer and perform better on standardized tests. Faced with future returns on long-term human capital investment, high school students in school may choose to take their studies seriously and go on to university, thus presenting the increased effect of rural road construction on the number of university students in columns 7–8 [43].

Table 6. Impact on social welfare.

	Number of Hospitals		Number of Hospital Beds		High-School Student		College Student	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
road	−0.508***	0.229***	0.342***	0.233***	−0.061	−0.027	0.370***	0.219***
	(−8.96)	(4.47)	(16.24)	(7.96)	(−0.91)	(−0.38)	(9.22)	(4.82)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	2034	1213	2034	1213	1015	1010	1405	1198
R^2	0.042	0.057	0.126	0.507	0.001	0.029	0.066	0.092

4.6. Robustness Test

To further confirm the robustness and reliability of the benchmark regression analysis results, the robustness test was followed by replacing the core explanatory variables. The mileage of three and four level highway construction plus brief and logarithm are used to represent the condition of rural road construction as the replacement variable of the core explanatory variable in this paper. The regression results in **Table 7** demonstrate the reliability and robustness of our conclusions. It shows that the construction of rural roads can indeed play a role in poverty reduction.

Table 7. Robustness test.

	Consumption Level		Consumption Structure		Grain Yield		Quantity of Meat	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
roads	1.521***	1.109***	0.766***	0.558***	0.0821*	0.288***	0.308***	0.343***
	(53.65)	(24.21)	(38.75)	(12.94)	(2.43)	(8.39)	(8.51)	(7.63)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1859	1157	1859	1157	1551	1093	1340	1001
R^2	0.635	0.682	0.476	0.397	0.004	0.099	0.060	0.132
	Fruit Production		**Vegetable Yield**		**Agriculture Employment**		**Transportation Employment**	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
roads	0.564***	0.650***	0.564***	0.663***	−0.330***	−0.320***	0.509***	0.600***
	(7.57)	(5.30)	(23.08)	(17.92)	(−8.41)	(−4.08)	(13.07)	(6.84)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1208	968	1208	999	1979	1192	1978	1192
R^2	0.054	0.066	0.347	0.368	0.038	0.061	0.088	0.244
	Manufacturing Employment		**Construction Employment**		**Disposable Income of Rural Residents**		**Urban-Rural Income Gap**	
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
roads	0.302***	0.510***	1.078***	1.760***	1.422***	1.039***	−0.074***	−0.063***
	(7.38)	(6.22)	(19.76)	(13.60)	(61.36)	(27.62)	(−28.97)	(−9.89)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1978	1192	1978	1192	1969	1186	1969	1186
R^2	0.030	0.267	0.181	0.327	0.681	0.721	0.323	0.241

Table 7. *Cont.*

	Number of Hospitals		Number of Hospital Beds		High-School Student		College Student	
	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
roads	−1.052***	0.183**	0.600***	0.660***	−0.0398	−0.003	0.566***	0.519***
	(−20.60)	(3.10)	(34.89)	(23.14)	(−0.59)	(−0.04)	(14.85)	(9.66)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1976	1190	1976	1190	998	993	1374	1174
R^2	0.193	0.047	0.408	0.661	-	0.026	0.159	0.153

5. Conclusions

Although rural road development is important, road connectivity remains a key challenge that needs to be addressed in rural areas of developing countries. Appropriate road infrastructure provides rural communities with more life opportunities and choices, ultimately improving the quality of life of rural residents and achieving the goal of poverty alleviation.

The purpose of rural road construction is to achieve the connection of tertiary roads in townships, hierarchical roads in organized villages, and hardened roads in large population natural villages (groups), laying a solid foundation for the construction of a strong transportation system. This paper estimates the impact of building rural roads in China. This paper found that rural road construction has indeed played an important leading and service supporting role in implementing the rural revitalization strategy. Rural road construction can reduce transportation costs, improve transportation efficiency, eliminate obstacles to labor mobility, and improve the lives of rural residents.

The regression results indicate that the construction of rural roads increased rural residents' consumption expenditure and promoted the upgrading and transformation of the consumption structure. More convenient transportation is also beneficial for the production of fresh foods such as meat and vegetables. Employing local rural residents to carry out the construction of rural roads absorbs rural labor locally and allows other surplus rural labor to shift from agriculture to other secondary and tertiary industries. This has increased the disposable income of rural residents and narrowed the gap between urban and rural incomes. Following the construction of good roads, public benefits provided by the government have also increased, such as increasing the number of beds in hospital clinics, as well as prompting school high school students to perform better and get into university.

This paper also emphasizes the important but not fully studied impact of rural roads. For example, rural road construction is premised on its potential to improve living conditions in rural areas, and the long-term economic impact will be greater than short-term estimates, reflecting the living conditions of future generations. As the largest developing country, China's development of rural road construction can provide reference cases for other developing countries. The construction of rural roads in China can effectively help rural residents reduce poverty, providing evidence for bridging the last mile of developing countries. Due to the limited availability of data, my research focuses on the construction of rural roads at the prefecture level city level from 2011 to 2019. The research conclusion may have a time lag. Meanwhile, the research area is at the city level, which is not as representative of the actual situation of rural residents as it is at the county level. Future research can further expand to the county level to conduct more in-depth and detailed investigations into the lives of rural residents.

Funding

This work received no external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Acknowledgments

The researcher would like to express her deepest gratitude to Mr. Chen Enqiang's support. Special thanks to everyone who has devoted themselves to researching and effectively improving the lives of impoverished people, which greatly enriches this study.

Conflicts of Interest

No potential conflict of interest was reported by the author.

References

[1] Benmaamar, M., 2006. Financing of road maintenance in sub-Saharan Africa. Reforms and Progress Towards Second Generation Road Funds. Available from: https://www.ssatp.org/sites/default/files/publications/SSATP-DiscussionPapers/dp06.pdf (cited 1 September 2006).

[2] Barrios, E.B., 2008. Infrastructure and rural development: Household perceptions on rural development. Progress in Planning. 70, 1–44. DOI: https://doi.org/10.1016/j.progress.2008.04.001

[3] Moller, L.C., Wacker, K.M., 2017. Explaining Ethiopia's growth acceleration—the role of infrastructure and macroeconomic policy. World Development. 96. DOI: https://doi.org/10.1016/j.worlddev.2017.03.007

[4] Aggarwal, S., 2021. The long road to health: Healthcare utilization impacts of a road pavement policy in rural India. Journal of Development Economics. 151, 102667. DOI: https://doi.org/10.1016/j.jdeveco.2021.102667

[5] Shamdasani, Y., 2021. Rural road infrastructure & agricultural production: Evidence from India. Journal of Development Economics. 152, 102686. DOI: https://doi.org/10.1016/j.jdeveco.2021.102686

[6] Xiao, H., Zheng, X.Y., Xie, L.Y., 2022. Promoting pro-poor growth through infrastructure investment: Evidence from the targeted poverty alleviation program in China. China Economic Review. 71, 101729. DOI: https://doi.org/10.1016/j.chieco.2021.101729

[7] Sun, C., 2022. Agriculture economic overview. Research on World Agricultural Economy. 3(4), 72–73. DOI: https://doi.org/10.36956/rwae.v3i4.803

[8] Gibson, J., Olivia, S., 2008. The effect of infrastructure access and quality on non-farm enterprises in rural Indonesia. World Development. 38(8/17), 717–726. DOI: https://doi.org/10.1016/j.worlddev.2009.11.010

[9] Ma, L.Y., Niu, D.X., Sun, W.Z., 2021. Transportation infrastructure and entrepreneurship: Evidence from high-speed railway in China. China Economic Review. 65, 101577. DOI: https://doi.org/10.1016/j.chieco.2020.101577

[10] Fiorini, M., Sanfilippo, M., Sundaram, A., 2021. Trade liberalization, roads and firm productivity. Journal of Development Economics. 7. DOI: https://doi.org/10.1016/j.jdeveco.2021.102712

[11] Xu, Y., Yang, X., 2021. Access to ports and the welfare gains from domestic transportation infrastructure. Journal of Urban Economics. 126, 103392. DOI: https://doi.org/10.1016/j.jue.2021.103392

[12] Liu, C., Wang, W., Wu, Q.F., 2019. Transportation infrastructure, competition and productivity: Theory and evidence from China. Economics Letters. 174, 74–77. DOI: https://doi.org/10.1016/j.econlet.2018.10.023

[13] Zou, W., Zhang, F., Zhuang, Z.Y., 2008. Transport infrastructure, growth and poverty alleviation: Empirical analysis of China. Annals of Economics and Finance. 9(2), 245–371.

[14] Banerjee, A., Duflo, E., Qian, N., 2020. On the road: Access to transportation infrastructure and economic growth in China. Journal of Development Economics. 145, 102442. DOI: https://doi.org/10.1016/j.jdeveco.2020.102442

[15] Faber, 2014. Trade Integration, Market size, and industrialization: Evidence from China's national trunk highway system. Review of Economic Studies. 81, 1046-1070. DOI: https://doi.org/10.1093/restud/rdu010

[16] Baum-Snow, 2017. Roads, railroads, and decentralization of Chinese cities. The Review of Economics and Statistics. 99(3), 435–448. DOI: https://doi.org/10.7910/DVN/FAZJE4

[17] Fan, S., Chan-Kang, C., 2008. Regional road development, rural and urban poverty: Evidence from China. Transport Policy. 15(5), 305–314. DOI: https://doi.org/10.1016/j.tranpol.2008.12.012

[18] Jones, S., Salazar, C., 2020. Infrastructure improvements and maize market integration: Bridging the Zambezi in Mozambique. American Journal of Agricultural Economics. 103(2), 620–642. DOI: https://doi.org/10.1111/ajae.12103

[19] Aiyar, A., Rahman, A., Pingali, P., 2021. India's rural transformation and rising obesity burden. World

Development. 138, 105258. DOI: https://doi.org/10.1016/j.worlddev.2020.105258

[20] Sam, A., Novosad, P., 2020. Rural roads and local economic development. American Economic Review. 110(3), 797–823.

[21] Gao, S., Yamada, M., Gao, D., et al., 2024. Coupling coordination analysis between total factor productivity and digital economy in China's agriculture. Research on World Agricultural Economy. 6(1), 1–22. DOI: https://doi.org/10.36956/rwae.v6i1.1425

[22] Information Office of the State Council Of the People's Republic of China, 2024. The development of rural roads in China in the new era. Available from: https://www.gov.cn/zhengce/202411/content_6990096.htm (cited 29 November 2024).

[23] Booth, D., Hanmer, L., Lovell, E., 2000. Poverty and transport: A report prepared for the world bank in collaboration with DFID. Final Report and Poverty and Transport toolkit. pp. 7–8.

[24] Bryceson, D.F., Bradbury, A., Bradbury, T., 2008. Roads to poverty reduction? Exploring rural roads' impact on mobility in Africa and Asia. Development Policy Review. 26(4), 459–482. DOI: https://doi.org/10.1111/j.1467-7679.2008.00418.x

[25] Faiz, A., 2012. The promise of rural roads: Review of the role of low-volume roads in rural connectivity, poverty reduction, crisis management, and livability. Transportation Research Circular: Washington, DC, USA. pp. 15–16.

[26] Wu, Y., Xu, G., Wang, X., et al., 2025. The impact of internet use and life satisfaction on household consumption expenditure: Based on empirical data from Chinese surveys. International Review of Economics & Finance. 97, 103767. DOI: https://doi.org/10.1016/j.iref.2024.103767

[27] Combes, P.P., Duranton, G., Gobillon, L.,2011. The identification of agglomeration economies. Journal of Economic Geography. 11(2), 253–266. DOI: https://doi.org/10.1093/jeg/lbq038

[28] Aggarwal, S., 2018. Do rural roads create pathways out of poverty? Evidence from India. Journal of Development Economics. 3, 375–395. DOI: https://doi.org/10.1016/j.jdeveco.2018.01.004

[29] Lu, H., Sun, G., Zhou, L.Y., et al., 2025. The impact and mechanism of e-commerce of agricultural products on nongrain production of cultivated land in rural China. Journal of Environmental Management. 373, 123639. DOI: https://doi.org/10.1016/j.jenvman.2024.123639

[30] Kebede H.A., 2022. Market integration and separability of production and consumption decisions in farm households. Journal of Development Economics. 158, 102939. DOI: https://doi.org/10.1016/j.jdeveco.2022.102939

[31] Gebresilasse, M., 2023. Rural roads, agricultural extension, and productivity. Journal of Development Economics. 162, 103048. DOI: https://doi.org/10.1016/j.jdeveco.2023.103048

[32] Huttunen, K., Riukula, K., 2024. Parental job loss and children's career choices. Labour Economics. 90, 102578. DOI: https://doi.org/10.1016/j.labeco.2024.102578

[33] Bounie, D., Camara, Y., Galbraith, J.W., 2020. Consumers' mobility, expenditure and online-offline substitution response to COVID-19: Evidence from French transaction data. Available from: https://doi.org/10.2139/ssrn.3588373 (cited 29 April 2020).

[34] Sewell, S.J., Desai, S.A., Mutsaa, E., et al., 2019. A comparative study of community perceptions regarding the role of roads as a poverty alleviation strategy in rural areas. Journal of Rural Studies. 71, 73–84. DOI: https://doi.org/10.1016/j.jrurstud.2019.09.001

[35] Braga, B., 2018. Earnings dynamics: The role of education throughout a worker's career. Labour Economics. 52, 83–97. DOI: https://doi.org/10.1016/j.labeco.2018.03.004

[36] Mashiri, M., Nkuna, Z., Chakwizira, J., et al., 2008. Strengthening informal healthcare delivery: gender perspectives. Proceedings of the 27th Southern African Transport Conference; 7–11 July 2008; Pretoria, South Africa. pp. 251–263.

[37] Eckman, 2022. Underreporting of purchases in the US consumer expenditure survey. Journal of Survey Statistics and Methodology. 10(5), 1148–1171. DOI: https://doi.org/10.1093/jssam/smab024

[38] Collie, D.R., 2022. CRRA utility and the sustainability of cooperation in infinitely-repeated games. Economics Letters. 221, 110897. DOI: https://doi.org/10.1016/j.econlet.2022.110897

[39] Kozelský, R., Maitah, M., Cvik, E.D., et al., 2024. Assessing the effect of monetary policy on the competitiveness of agricultural enterprises. Research on World Agricultural Economy. 5(2), 68–81. DOI: https://doi.org/10.36956/rwae.v5i2.1080

[40] Diaz-Gutierrez, J., Ranjbari, A., 2024. How effective are fixed-effects models in fixing the transit supply-demand bidirectional interaction? Transportation Letters. 1–14. DOI: https://doi.org/10.1080/19427867.2024.2422713

[41] Marfo-Ahenkora, E., Ameleke, G.Y., Taah, K.J., et al., 2024. Economic effects of using improved maize varieties, inorganic fertilizer and goat manure in smallholder farms: Evidence from field evaluations in southern Ghana. Research on World Agricultural Economy. 6(1), 39–51. DOI: https://doi.org/10.36956/rwae.v6i1.1365

[42] Mazibuko, S., 2013. Understanding underdevelopment through the sustainable livelihoods approach. Community Development. 44(2), 173–187. DOI: https://doi.org/10.1080/15575330.2012.683798

[43] Adukia A., Asher S., Novosad P., 2017. Educational investment responses to economic opportunity: evidence from Indian road construction. SSRN Electronic Journal. 12(1), 348–376. DOI: http://dx.doi.org/10.2139/ssrn.2827365

[44] Galor, O., Moav, O., Vollrath, D., 2009. Inequality in landownership, the emergence of human-capital promoting institutions, and the great divergence. The Review of Economic Studies. 76(1), 143–179. DOI: http://dx.doi.org/10.2139/ssrn.670883