



Study on the Pavement Maintenance Quality of Rural Roads in Nonpolicy Supported Areas

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Abstract. To address emerging imbalances in rural road maintenance, this study centers on evaluating pavement maintenance quality of rural roads. Utilizing the sound and moderate road rate (SMRR), which is derived from the Pavement Maintenance Quality Index (PQI), this study assesses pavement maintenance quality. The analysis includes 1607 nonpolicy-supported counties out of a total of 2717 national counties tasked with rural road maintenance. The results reveal that the pavement maintenance quality in nonpolicy-supported areas generally surpasses both the national and policy-supported averages. Nonetheless, disparities are evident: 30 counties in the eastern region, 109 in the central region, and 108 in the western region exhibit pavement maintenance quality below the western region's average, underscoring a lag in these nonpolicy-supported areas. The study recommends field surveys in counties with subpar SMRR and inferior pavement maintenance quality, proposing an adjustment in policy support levels accordingly.

Keywords: Rural road, Pavement maintenance quality, Sound and moderate road rate, Chinese, Policy

1 Introduction

Supporting economically disadvantaged regions has consistently been a focal point of China's transportation development strategy [1-2]. Since the 1980s, facilitating the development of "old, minority, border, and impoverished" areas has constituted a specific objective within China's regional policies [3-4]. During the "Eleventh Five-Year Plan" period, Ministry of Transport of the People's Republic of China intensified its backing for the construction of rural roads in the central and western "old, border, and impoverished" areas, raising subsidy standards. In the "Twelfth Five-Year Plan", the Ministry sustained this support and substantially elevated the subsidy standards for transportation infrastructure development in contiguous impoverished regions. In the context of

the "Thirteenth Five-Year Plan", the Ministry issued the "Transportation Poverty Alleviation Plan for the Thirteenth Five-Year Plan," resulting in a substantial increase in central investment subsidies for transportation infrastructure development in impoverished regions. These subsidies for the construction of hardened roads in townships and villages now exceed 70% of the average construction cost. In the current "Fourteenth Five-Year Plan", the Ministry continues to extend its support to rural road construction in 160 key counties as part of the broader initiative for rural revitalization.

The primary objective of this policy support is to rectify the disparities in rural road development, elevate the national standard of rural road infrastructure, and stimulate sustainable transportation development [5]. Areas receiving this support predominantly include regions characterized by weaker economic conditions, limited fiscal capacity, delayed transportation infrastructure development, or historical challenges. As a consequence of this policy intervention, China's rural road network has undergone substantial progress [6], with the total mileage expanding from 3.678 million kilometers in 2012 to 4.531 million kilometers by the conclusion of 2022.

However, amidst the continued policy support for rural roads, new disparities in rural road development have surfaced. Some provinces feature economically disadvantaged areas that have not enjoyed policy benefits and lack "revolutionary transformation," leading to issues such as low technical grade, outdated infrastructure, and road deterioration. Strikingly, the rural road conditions in these regions even lag behind those in some counties that have undergone poverty alleviation initiatives. Therefore, this study undertakes an analysis of the quality of pavement maintenance on rural roads in 1607 nonpolicy-supported counties, drawn from a total of 2717 national counties assigned rural road maintenance responsibilities. The objective is to scrutinize the emerging disparities in rural road development and formulate recommendations for addressing these challenges.

2 Evaluation Indicators

PQI serves as a comprehensive metric for assessing various aspects of pavement conditions, including pavement surface, pavement roughness, pavement rutting, pavement bumping, pavement wearing, pavement skidding resistance, and pavement structural strength. This study employs the PQI as the primary index for calculating the SMRR and for evaluating the level of road conditions [7].

The SMRR reflects the technical conditions of rural roads and is classified into five categories, excellent, good, moderate, substandard, and poor, based on the Highway Performance Assessment Standard (JTG 5210-2018). The classification criteria are outlined in Table 1.

Table 1. Classification Standards for the Technical Condition of Rural Roads

Assessment Indicator	Excellent	Good	Moderate	Substandard	Poor
PQI	≥ 90	$\geq 80, < 90$	$\geq 70, < 80$	$\geq 60, < 70$	< 60

The SMRR correlates with premium road length (PRL), good road length (GRL), and moderate road length (MRL) of rural roads in relation to the total road length (TRL). It is calculated using the formula shown in Equation (1):

$$SMRR = (PRL + GRL + MRL)/TRL \quad (1)$$

3 Data Source

According to national regulations, county-level governments bear the responsibility for the construction and maintenance of rural roads. Currently, 2717 county-level administrative units in China are responsible for rural road maintenance, accounting for 95.6% of the national total. Four categories of areas have received policy support: 160 key counties for national rural revitalization assistance, 832 former national poverty-stricken counties, 211 deeply impoverished counties, and 1177 counties within the scope of the "Thirteenth Five-Year" Transportation Poverty Alleviation Plan. After consolidating and deduplicating these categories, there are 1110 counties in policy-supported areas. Therefore, out of the 2717 county-level administrative units with rural road maintenance tasks, 1607 are in nonpolicy-supported areas. The SMRR data for these areas are sourced from the Road Maintenance Statistical System.

4 Analysis Of Pavement Maintenance Quality in Rural Roads in Nonpolicy Supported Areas

4.1 Overall Analysis of Pavement Maintenance Quality in Nonpolicy Supported Areas

Table 2 shows the SMRR based on PQI for various regions nationwide. The western region has the lowest average SMRR across the eastern, central, and western regions, with nonpolicy-supported areas demonstrating higher overall levels than policy-supported areas.

Table 2. Comparison of SMRR Based on PQI in Different Regions

Type of Area	Overall Region	Eastern Region	Central Region	Western Region
Nonpolicy Supported Areas	82.58%	87.97%	81.51%	74.48%
Policy-Supported Areas	72.12%	83.38%	80.29%	66.37%
National Average	78.07%	87.12%	81.07%	69.04%

4.2 Analysis of Pavement Maintenance Quality in Rural Roads in Eastern Nonpolicy Supported Areas

Among the counties with maintenance responsibilities, 641 are located in the eastern nonpolicy-supported regions, which include 11 provinces: Beijing, Fujian, Guangdong, Hainan, Hebei, Jiangsu, Liaoning, Shandong, Shanghai, Tianjin, and Zhejiang. The overall SMRR in these areas exhibited a relatively high standard, with 547 counties (85.3%) surpassing the national average. Figure 1 depicts the distribution of SMRR in counties falling below the average in the western region.

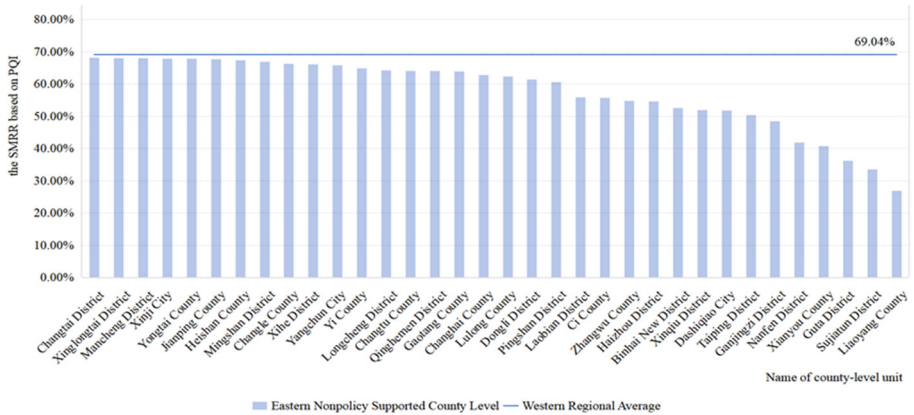


Fig. 1. Comparison of the SMRR of Eastern Nonpolicy Supported Counties Below the Western Region Average

Thirty-four counties possess rural roads, with SMRR falling below the average for the western region, as illustrated in Figure 2. These counties span six provinces: Fujian, Guangdong, Hebei, Liaoning, Shandong, and Tianjin. Notably, Liaoning has the highest concentration of such counties, with 22 counties falling below the western region's average. Among these, Liaoyang County in Liaoning exhibits the lowest SMRR in the eastern nonpolicy supported areas, at only 26.93%.

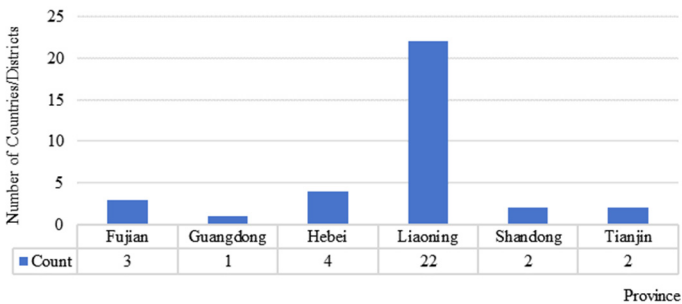


Fig. 2. displays the distribution of counties in the eastern nonpolicy supported areas with an SMRR below the western region's average.

4.3 Analysis of Pavement Maintenance Quality in Rural Roads in Central Nonpolicy Supported Areas

Among the counties entrusted with maintenance duties, 551 are situated in central non-policy-supported regions, including eight provinces: Anhui, Henan, Heilongjiang, Hubei, Hunan, Jilin, Jiangxi, and Shanxi. The overall SMRR in these areas has maintained a relatively high level, with 368 counties (66.8%) surpassing the national average. Figure 3 illustrates the distribution of SMRR in counties falling below the average in the western region.

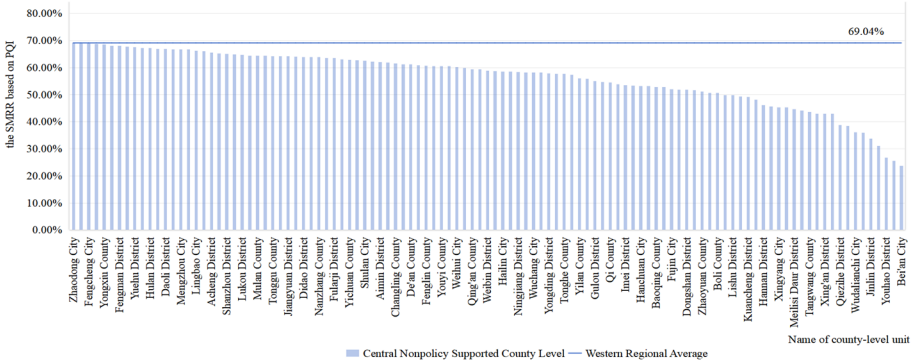


Fig. 3. Comparison of the SMRR of Central Nonpolicy Supported Counties Below the Western Region Average

109 counties possess rural roads, with SMRR falling below the average for the western region, as illustrated in Figure 4. Specifically, these counties are located within Heilongjiang, Hubei, Hunan, Jilin, Jiangxi, and Shanxi Provinces. Among these, Heilongjiang Province has the largest number of counties falling below the western region's average, with 58 such counties. Beian city in Heilongjiang Province has the lowest SMRR in the central nonpolicy supported areas, at just 23.69%.

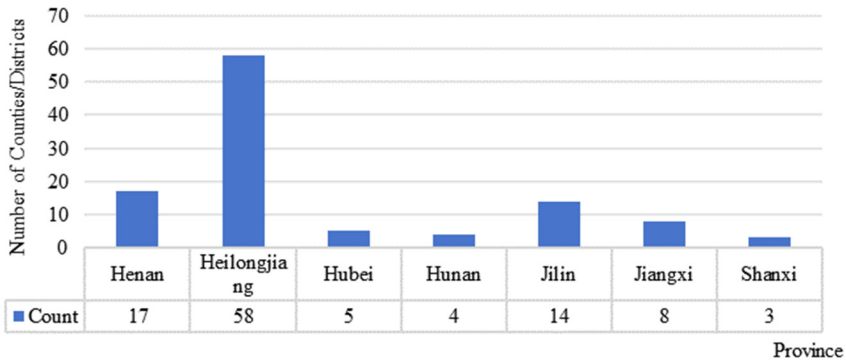


Fig. 4. Distribution of Counties in Central Nonpolicy Supported Areas with SMRR Below the Western Region Average

4.4 Analysis of Pavement Maintenance Quality in Rural Roads in Western Nonpolicy Supported Areas

Within the group of counties assigned maintenance responsibilities, 353 are situated in the western nonpolicy-supported regions, spanning 11 provinces: Gansu, Guangxi, Guizhou, Inner Mongolia, Ningxia, Qinghai, Shaanxi, Sichuan, Xinjiang, Yunnan, and Chongqing. Notably, among these counties, 165 (46.7%) exhibit an SMRR surpassing the national average. Figure 5 shows the distribution of SMRR in counties falling below the western region's average.

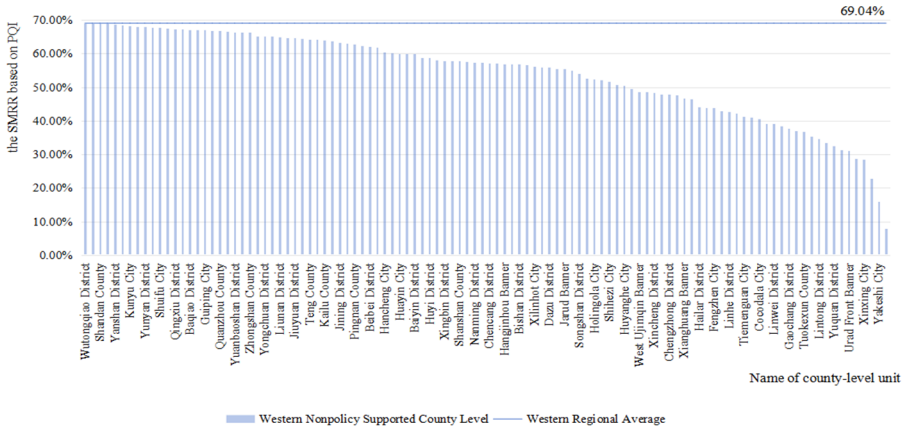


Fig. 5. Comparison of the SMRR of Western Nonpolicy Supported Counties Below the Western Region Average

There are 108 counties where rural road conditions fall below the western region's average, as illustrated in Figure 6. Among these counties, Inner Mongolia has the highest count, with 35 counties falling below the average in the western region. Notably, Genhe city in Inner Mongolia has the lowest SMRR in the western nonpolicy-supported areas, representing the lowest SMRR nationwide among nonpolicy-supported regions, at a mere 7.88%.

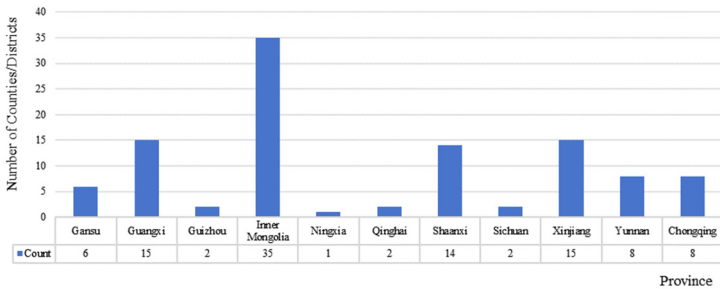


Fig. 6. Distribution of Counties in Western Nonpolicy Supported Areas with SMRR Below the Western Region Average

5 Conclusion

This study, grounded in an assessment of the technical conditions of rural roads and utilizing the SMRR based on PQI, conducts an analysis of the emerging disparities in rural road maintenance across 2717 counties tasked with rural road maintenance responsibilities. The primary findings are as follows:

(1) The overall quality of pavement maintenance in nonpolicy-supported areas surpasses that in both national and policy-supported areas.

(2) In the eastern region, 30 nonpolicy-supported counties exhibit SMRR below the western region's average, while in the central region, this number is 109; in the western region, this number is 108. These figures indicate a disparity in pavement maintenance quality in these nonpolicy-supported areas.

(3) It is recommended to initiate field surveys within nonpolicy-supported counties characterized by low SMRR and suboptimal pavement maintenance quality. Subsequently, policy support levels should be adjusted in accordance with the findings.

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