



Factors influencing the efficiency of rural public goods investments in mountainous areas of China — Based on micro panel data from three periods



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ABSTRACT

China's countryside is undergoing massive transformation under the background of rapid urbanization and industrialization; however, urban-rural gaps and regional gaps have become obvious in this process. It is necessary to restructure rural production, living and ecological spaces by investing public goods appropriately, to thereby establish a new platform for building a new countryside and realize urban-rural integration development. Mountainous areas are an important type of human-land relationship system, but the levels of rural economic development and public services in mountainous areas are significantly lower than those in the plains. This paper examines 12 years of data from tracking surveys, adopts a method that combines economics and geography, and conducts dynamic monitoring and evaluations of the efficiency of rural public goods investments in specific mountainous areas. The results show that rural public infrastructure and public services in mountainous areas are increasingly valued and have received considerable support in terms of government financial contributions. Moreover, the burden of investments at the village level continues to decrease, the technical efficiency of rural public investments has risen to relatively high levels, and scale efficiency plays a crucial role in public investment efficiency. Furthermore, natural terrain, location and transportation remain significant factors that influence the efficiency of rural public investments in mountainous areas. However, village-level democratic systems and village governance have gradually become key factors that influence public investment efficiency. Based on such results, this research offers policy recommendations for increasing the efficiency of public fund usage and promoting rural restructuring.

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1. Introduction

Building a new countryside is an important strategy adopted by the central government of China. China's countryside is going through a massive change under the background of rapid urbanization and industrialization, leading to the restructuring of the geographic space pattern and social economic status. Long et al.

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(2010) argue that regional discrepancies, rural poverty, rural land-use issues and the present international environment are four major potential factors involved in building a new countryside. These factors are closely linked with rural public goods investment. Mountainous areas, which account for more than two-thirds of China's territory, are an important type of human-land relationship system with a complicated topography and fragile ecological environment. In mountainous rural areas, poor public infrastructure and contradictions between public service supply and demand seriously hinder rural development and restructuring. It is necessary to strengthen public infrastructure; improve public service capacity; and restructure rural production, living and ecological space by investing public goods appropriately and efficiently, to thereby establish a new platform for building a new countryside

and realize urban-rural integration development.

Improvements to public services and infrastructure are a driving factor in rural development and restructuring (Bournaris et al., 2014; Li et al., 2015). Shen et al. (2012) hold that good public services are essential for effective use of resources and for strengthening cooperation in rural regions, whilst Yu et al. (2014) found that a developed transport network contributes to accelerating agricultural modernization in rural areas.

Mountainous areas represent relationship systems between humans and land, account for more than two-thirds of China's territory and are primarily distributed in the western regions (Chen et al., 2010). In recent years, China's governments have continuously increased investments in rural public services in mountainous areas so that problems related to insufficient public investment in rural areas have been alleviated to some extent. However, inefficient investments and other problems have become increasingly prominent, as mainly reflected in repeated construction, wasted funds and investments that do not consider the actual needs of local farmers (Lin, 2014). In developing countries such as China, investments in roads, education, health services, safe drinking water, communications and other key public goods have a significant impact on poverty alleviation, new rural construction and overall regional development (Liu et al., 2007).

Academic studies on rural public goods investments have been conducted for some time and have achieved important results. Peter (2001) conducted an investigation and analysis of the process and effects of reconstruction in Colorado, Washington, Idaho, Utah and other rural areas in the western United States and reported that government public investments played an important role in the process of developing small rural communities into boomtowns. Dominique (2002) quantified the investment income derived from publicly funded rural roads and argued that rural poverty reduction can be achieved through public road investments. Ida (2003) proposed that the central government was the most important provider and distributor of public infrastructure construction, social security, education and other resources. Anjini et al. (2009) discussed the influence of India's rural public goods investments on poor groups. Martin (2012) studied four cases in rural areas of Poland between 1990 and 2005 and discovered that cooperation between local government and civil organizations to provide public goods was conducive to promoting local rural economic development. Henk et al. (2013) investigated the structures of supply and demand for agricultural public goods and found that balancing agricultural supply and demand was difficult; they suggested that effective policies and measures must be defined from current and potential supply and demand.

Zhang, Rozelle and other researchers have presented more efficient research into China's rural public services; Yi et al. (2009) used household surveys to study the design and implementation schedule of China's new rural medical system and discovered that the greatest weakness in China's new rural medical system was that effective treatment for critical diseases was not guaranteed. Liu et al. (2009) conducted a detailed analysis of the current status and problems related to the construction of the rural infrastructure in China and found that, despite increased investments into rural public infrastructure, the quality of infrastructure had not improved. Wong et al. (2013) explored methods of improving the quality of rural infrastructure and suggested that the construction of high-quality, cost-effective rural roads requires the full cooperation of village cadres and government agencies. Using the most recent research results, Qiao et al. (2014) found that road widening has a significant impact on local non-farm employment income and working hours. Wang and Lin (2010) observed a number of difficulties related to supplying rural areas with public goods. Chen (2013) determined that direct measures can be used to identify

village officials who are embedded in a social group and have a positive effect on the provisioning of public goods in rural China.

Liu and other researchers conducted additional studies of rural employment, floating populations and public services in the mountains of China's western region. Zhang and Liu (2012) analyzed and evaluated the current status and benefits of rural public investment in mountainous areas of Sichuan Province according to five major public projects: roads, living water, irrigation facilities, schools and clinics. Liu et al. (2014) used a multivariate regression model and digital elevation model to discuss the location of rural migrant workers in mountainous areas of China's Sichuan Province. Guo et al. (2014a) found that in recent years, frequent earthquakes, landslides and other geological disasters had occurred that had seriously affected and destroyed farmers' livelihood and assets and led to changes in the farmers' livelihood selections in mountainous areas. Through a field survey of rural public goods in mountainous areas of Sichuan Province, Guo et al. (2014b) discovered that natural conditions are the most important determinants of public goods investments in rural communities and those steep-sloped, mountainous villages had relatively high levels of investment.

Few studies have investigated the rural public investment efficiency in mountainous areas, which are considered special terrain areas, whereas general studies of public investment efficiency are relatively abundant. Norihiko and Toru (2002) examined the effect of public goods investments on Japan's regional economics and quantitatively described the trade-off between efficient and equitable allocations of public goods investments. Antonio and Sonia (2008) adopted the semi-parametric analysis and data envelopment analysis (DEA)-Tobit two-phase method to evaluate the efficiency and influencing factors of public goods investments by Portugal's local government and found that the primary reason for inefficiency in public investments was that the government had not achieved a scale of production. Jana and Michal (2011) also used the method of multi-indicators to quantitatively evaluate government expenditure efficiency related to public environmental protection. Li and Zeng (2006) adopted the Brown-Jackson estimation method to analyze the effect of rural public expenditures in China's eastern, central and western regions according to the influencing factors of rural public expenditures and the impact of public expenditures on private consumption. Zhu et al. (2010) analyzed the national macroeconomic statistics between 2005 and 2007 and used the DEA method to conduct an empirical analysis of the efficiency of public services in the rural areas of 28 provinces (autonomous regions and municipalities) and they measured the comprehensive technical efficiency, pure technical efficiency (PTE) and scale efficiency (SE) and estimated the coefficients of variation.

Important research has been performed on rural public goods investments and investment efficiency that can be used as a reference for future research. However, deficiencies remain in the extant studies on the efficiency of rural public goods investments. First, few empirical studies have been based on micro sampling survey data and even fewer studies have been based on dynamic tracking. Second, studies on the factors that influence the efficiency of public investments primarily analyze the society and economy, whereas limited studies have analyzed the combination of natural factors and location factors. Third, limited research has analyzed rural public goods investments in specific terrain areas, especially in mountainous areas.

2. Study area and data sources

2.1. Study area and sampling procedure

This paper took Sichuan province as the study area, which

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