

Impact of Innovative Agricultural Green Technology Application on Agricultural Green Total Factor Pro- ductivity

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Abstract. This study examines the impact of innovative agricultural green technology (AGTI) on agricultural green total factor productivity (GTFP) and the regulatory role of environmental regulation (ER). Using panel data from 30 Chinese provinces (2011-2022) and a two-way fixed effect model, it finds that AGTI significantly boosts GTFP, highlighting its positive role in sustainable agriculture. This suggests that adopting new green technologies can enhance agricultural efficiency and reduce environmental impact, crucial for long-term sector sustainability. However, further analysis shows that ER negatively affects the relationship between AGTI and GTFP. Strict regulations may add costs or constraints to new technology implementation, hindering productivity improvements. To ensure reliability, endogeneity was addressed using instrumental variables, and robustness was tested by varying model specifications and considering different industrial structures and regional heterogeneity. The core conclusions remained robust across models and samples. The study offers a new perspective on the economic effects of agricultural green technology and provides insights for policy-makers. It emphasizes balancing ER intensity with AGTI promotion. A well-calibrated regulatory approach is needed to avoid over-restricting green technology adoption, which could limit agricultural productivity and sustainability gains.

AMS subject classifications: 90C08, 90B50

Key words: Innovative agricultural green technology, Green total factor productivity of agriculture, Green agriculture, Heterogeneity.

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1 Introduction

With the increasingly severe global climate change and environmental problems, green development has become a global consensus. As a basic industry for human survival and development, the transformation to green agriculture is of vital significance to the realization of sustainable development. Existing literature on green total factor productivity in agriculture mainly focuses on the digital economy [1], ER [2], regional differences and heterogeneity [3], technological progress and innovation, to discuss the digital economy, land circulation [4], agricultural insurance [5], agricultural planting structure [6] the influence of other factors on GTFP, but there are few literatures exploring the influence of AGTI on GTFP from the perspective of agriculture. Sun and Zhong [7] more attention to the impact of digital inclusive finance and digital economy on GTFP. Such as Zhou [8] the research pointed out that digital technology has significantly improved the agricultural total factor productivity by optimizing the allocation of production factors and promoting industrial upgrading. There are also some scholars, such as Luo [9] from the perspective of ER, it reveals the positive and non-linear relationship between ER and GTFPy and propose to optimize this influence through technological innovation and policy adjustment. In addition, most of the existing studies discuss the green total factor productivity of agriculture from the perspective of regional differences and heterogeneity, but ignore the differences in internal agricultural endowment and external agricultural natural environment in different regions.

This study using the provincial panel data from 2011-2022, such as using SBM (Slacks-Based Measure) super efficiency model and GML (Global-Malmquist-Luenberger) index method tools of 30 provincial GTFP, the AGTI effect of GTFP and regional heterogeneity, and discusses the regulation effect of ER, in order to promote AGTI and agricultural green coordinated development of total factor productivity, enhance the level of GTFP to provide theoretical support.

2 Theoretical analysis and research hypothesis

2.1 Influence of the application of AGTI on GTFP

The application of AGTI has become a key force in promoting the green transformation of agriculture. These technologies have played a significant role in promoting the green total factor productivity of agricultural production by improving the efficiency of resource utilization, reducing the use of chemical inputs and enhancing the stability of the agricultural ecosystem. Innovative agricultural green technologies, such as precision agriculture, biotechnology, and water-saving irrigation systems, have improved the utilization efficiency of land, water resources and energy by optimizing agricultural production processes. This increase in efficiency is directly reflected in the growth of green total factor productivity in agriculture, as it covers the entire transition process from factors of production to output. These techniques, by reducing the overuse of fertilizers and