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Does crop diversification improve sustainability and farm performance? Evidence from irrigated areas in Kyrgyzstan

MARLEN TYNALIEV¹, NODIR DJANIBEKOV¹, THOMAS HERZFELD^{2,1}

¹*Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Agricultural Policy Department, Germany*

²*Martin-Luther-Universität Halle-Wittenberg, Inst. of Agricultural and Nutritional Sciences, Germany*

Abstract

This study investigates the effects of crop diversification on environmental sustainability and farm performance among smallholder farmers in Kyrgyzstan. Using primary data collected from 410 farmers in the Jalal-Abad region, specifically Bazar-Korgon district, during a post-experimental survey conducted in October–November 2024, the analysis focuses on three key outcomes: sustainable agricultural practices, total crop revenue, and farm productivity. Crop diversification is measured using the Simpson Diversity Index, while sustainability is captured through a composite indicator reflecting environmentally oriented farm management practices.

To address potential endogeneity in farmers' diversification decisions, the study employs a Control Function Approach combined with a Seemingly Unrelated Regression framework. This empirical strategy enables consistent estimation of the effects of diversification across multiple outcomes while accounting for unobserved heterogeneity. The results indicate a non-linear relationship between crop diversification and all three outcomes. Sustainability and productivity improve with diversification up to a certain level, after which the benefits decline, while crop revenue continues to increase within the observed range, albeit at a decreasing rate. These findings indicate that the optimal level of diversification differs across outcomes.

The results highlight the importance of crop diversification as an adaptation strategy in the context of Kyrgyzstan's smallholder farming systems, which are characterised by resource constraints and environmental pressures. However, the benefits depend on maintaining a balanced level of diversification, as excessive diversification may increase management complexity and reduce efficiency. Overall, the study provides novel empirical evidence from Central Asia on the effects of crop diversification on sustainability and farm performance, with important implications for agricultural policy and rural development.

Keywords: Control function approach, crop diversification, crop revenue, farm productivity, Kyrgyzstan, seemingly unrelated regression, smallholder farmers, sustainable agricultural practices