

Evaluating Technical Efficiency and Technology Gaps in Asian Agriculture: A Stochastic Meta-frontier Analysis

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Agriculture plays a vital role in poverty alleviation across Asian countries as a considerable portion of the rural population depends on it for their livelihood. However, the Asian agriculture sector faces numerous challenges, including fluctuations of input prices, shifting consumer demands with population growth, unsustainable farming practices and most importantly, the impacts of climate change and extreme weather conditions. To overcome these challenges, Asian countries aim to maximize their output efficiently using available inputs. This study reveals the current efficiency levels and potential improvements in Asian agriculture by assessing technical efficiency and technology gap ratios in the whole agricultural sector, including crop production, livestock, and integrated farming systems across 28 Asian countries from 1992 to 2021, classified based on income levels. The Cobb-Douglas production function was used as the functional form of stochastic frontier analysis, covering key inputs- land, labor, fertilizer, and pesticides. Deflated values of agricultural production served as the primary output variable. The study examines variations in production technologies among high-income, upper-middle-income, and lower-middle-income countries using a stochastic meta-frontier model. The findings indicate that the average technical efficiency in the Asian agricultural production is 0.54, showing that agricultural output could increase by 46% if all countries operated at their maximum efficiencies. Among three income groups, upper-middle income countries exhibited the highest average technical efficiency at 0.82, showing their capacity to utilize inputs relative to their group-specific production frontiers. Technology gap ratios further highlighted the disparities in potential output, with high-income countries reaching 52% of their potential, while upper-middle income countries and lower-middle income countries achieving 62% and 49% respectively. These findings emphasize the need for targeted interventions, such as facilitating technology transfer from high-performing countries, investing in extension services, improving access to quality inputs, and encouraging data-driven agricultural practices, especially in lower-middle income countries to enhance technical efficiency and bridge the efficiency gaps.

Keywords: Asian agriculture, Income level, Stochastic meta-frontier, Technical efficiency