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## Agricultural Intensification and Land Use Change: Testing the Induced Intensification, Land Sparing and Rebound-Effect Hypotheses with Cointegration

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### Abstract

The growing societal demands for land-based products and services, linked to increasing population, can be satisfied through either clearing new land for agriculture or intensifying production on existing land. Agricultural intensification is promoted as a central strategy to fulfil these demands while reducing the pressure on land. We used cross-country panel data on cropland area and productivity to test three hypotheses on the relationships between agricultural intensification, land use expansion and contraction. The induced intensification hypothesis postulates that restrictions on cropland expansion and increased demand per unit area can induce intensification. The land sparing hypothesis postulates that intensification allows reducing cropland expansion, while the competing rebound-effect hypothesis asserts that intensification, by making agriculture more profitable, can trigger further land use expansion. We used cointegration to disentangle the long-run and short-run causal relationships between the variables. For all crops together, in the short run, we found support for the induced intensification hypothesis for high-income countries, and rebound effect for middle- and low-income countries (due to increases in yield or total factor productivity (TFP) that lead to cropland expansion). In the long-run, the land sparing hypothesis holds for low- and middle-income countries (due to increases in yield negatively affecting cropland area). TFP has a positive effect on yields for low- and middle-income countries. We then test the same hypotheses for specific crops in different contexts, such as soybean in South American countries and staple crops in sub-Saharan Africa. These results show how different conditions in terms of the elasticity of the demand to price changes, potential for land use expansion and trade orientation affect the relations between changes in cropland area and productivity.

**Keywords:** Agricultural contraction, cross-country, agricultural expansion, panel