

Proposal master thesis: A Global Decomposition of Pesticide Use

Topic:

“A Global Decomposition of Pesticide Use”

Background:

While pesticides are used around the globe, the intensity and the risk that pesticides pose differ widely. To improve the understanding of this heterogeneity, this thesis will decompose global pesticide trends in three parts: changes in pesticide use linked to i) changes in agricultural output, ii) changes in the pesticide input intensity (share of pesticides in inputs), and iii) changes in pesticide or total factor productivity (output produced per input). For example, a decomposition of agricultural greenhouse gas emissions has previously shown that improvements in total factor productivity are mainly responsible for the reduction in agricultural emissions (Ortiz-Bobea and Pieralli, 2026).

Proposed methods:

It will build on the following mathematical identity (Ortiz-Bobea and Pieralli, 2026):

$$(1) \Delta P = \Delta Y + \Delta(P/X) - \Delta(Y/X)$$

Where P is pesticide use, Y is agricultural output, and X is an aggregate index for the most important agricultural inputs (land, labor, capital, materials weighted by cost shares). This will allow a description of which components were most relevant for changes in pesticide use. Based on the results the student will differentiate between changes in the overall amount of crop production, pesticide efficiency, e.g., due to technological change, or the general change in agricultural productivity (TFP) were most relevant for the development of pesticide use in different countries over time. The analysis will be conducted on an aggregate level of the agricultural sector per year and country, using FAO/trade-corrected FAO data for pesticides (Shattuck et al., 2023) and USDA ERS data for global production data.

Literature:

Ortiz-Bobea, A., Pieralli, S., 2026. Unpacking the growth of global agricultural greenhouse gas emissions. Science Advances 12, eaeb8653. <https://doi.org/10.1126/sciadv.aeb8653>

Shattuck, A., Werner, M., Mempel, F., Dunivin, Z., Galt, R., 2023. Global pesticide use and trade database (GloPUT): New estimates show pesticide use trends in low-income countries substantially underestimated. Global Environmental Change 81, 102693. <https://doi.org/10.1016/j.gloenvcha.2023.102693>

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