Does El Niño bring unusually severe rice shortfalls in Southeast Asia?

Pietro Sala

2026-11-23

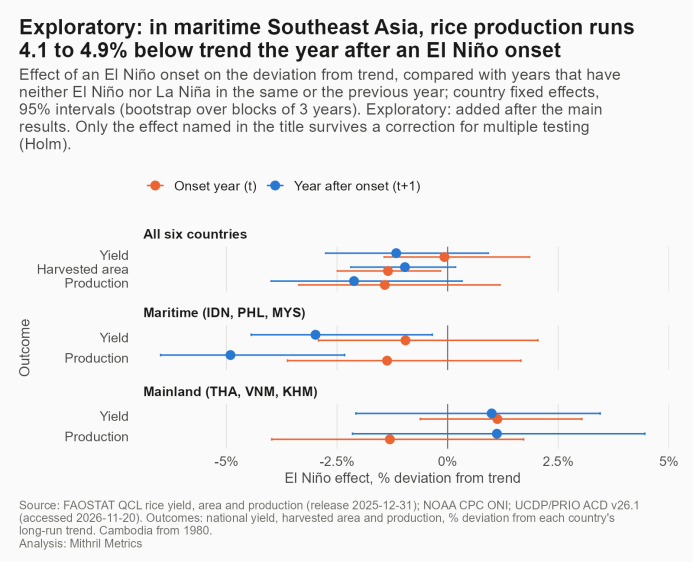
Question. Are national rice yield shortfalls in Southeast Asia (Viet Nam, Indonesia, Philippines, Thailand, Malaysia, Cambodia; 1961-2024) larger and more frequent in El Niño onset years, and more extreme than a normal distribution implies?

Short answer. Not in the year it begins. Across six Southeast Asian countries since 1961, El Niño onset years show no detectable rise in national rice shortfalls of 5% or more (11% of country-years vs 15% otherwise; the difference is within chance, not a sign that El Niño helps). **In an exploratory check, rice production in Indonesia, the Philippines and Malaysia runs 4.1 to 4.9% below trend the year after an onset**, depending on how countries are weighted; on the mainland there is no detectable effect (+1.1%, 95% interval −2.1% to 4.5%). Harvests 10% or more below trend are rare (11 of 365 country-years), and 8 of the 11 came before 1980.

1. Data and method

We compare how often national rice harvests fall well below trend in El Niño onset years and in other years. *Data.* FAOSTAT QCL national rice (paddy) yield, harvested area and production for Viet Nam, Indonesia, the Philippines, Thailand, Malaysia and Cambodia, 1961-2024 (365 country-years; Cambodia from 1980), and NOAA's Oceanic Niño Index (ONI). *Shocks.* For each country and outcome, the log deviation from a natural cubic spline trend with 4 degrees of freedom, with a level shift for Indonesia from 2018 (series break). *Exposure.* An onset year has a July-December ONI mean of at least 0.5°C (19 years); strong onsets at least 1.5°C (6 years). *Main estimate.* A linear probability model of a yield shortfall of at least 5% below trend on an onset indicator with country fixed effects. Tail frequency compares observed shortfalls of 10% or more with normal benchmarks built from each country's robust (median absolute deviation) or classical standard deviation. *Exploratory regional look.* Yield, area and production shocks on El Niño and La Niña indicators for the onset year and the year after, by region (maritime: Indonesia, the Philippines, Malaysia; mainland: the rest), against years with neither in the same or previous year; Holm correction over 14 contrasts and a rotation placebo of the ENSO calendar. *Inference.* Moving-block bootstrap (999 draws) resampling whole years in blocks of 3, which keeps the correlation across countries within a year and persistence across years; country spreads are re-estimated in each draw, the trend is treated as known. *Identification* rests on ENSO timing being unrelated to other drivers of detrended national rice output; estimates include policy and farmer responses.

2. Results



- **Onset years show no rise in shortfalls of 5% or more.** Change in the probability against other years: −3.7 percentage points (95% interval −11.0 to 3.6); for shortfalls of 10% or more: −0.3 (-4.1 to 2.9).
- **Deep shortfalls exceed a bell curve only against the typical-year spread.** Shortfalls of 10% or more occur 8.3 times (1.3 to 25.0) the rate a normal curve predicts with each country's typical-year spread, and 1.4 times (0.8 to 2.2) with the all-year spread; 8 of 11 came before 1980.
- **Exploratory: maritime production runs below trend the year after an onset.** −4.9% (-6.5% to −2.3%); weighted by output −4.1% (-5.8% to −1.4%). Mainland: +1.1% (-2.1% to 4.5%); difference −6.0 percentage points (-9.0 to −2.7).
- **In tonnes, the weighted gap is about 3.2 million t of paddy** at 2024 trend output (1.1 to 4.5), of which Indonesia 2.3, split in proportion to trend output.

3. Robustness checks

- **The onset-year result holds across checks.** Exposure in the year after onset: 5.5 pp (-2.7 to 14.8); LOESS trend: −2.1 pp (-8.6 to 4.2); without FAO-estimated values: −4.1 pp; without major-conflict country-years: −3.9 pp; without 1997-98: −3.2 pp. Shift of the 10th percentile of shocks in onset years: +0.9% (-1.5% to 3.4%).
- **The tail shape is not pinned down.** Generalised Pareto shape 0.08 (-0.32 to 0.48; 55 exceedances), consistent with thin and heavy tails. The typical-year ratio is 7.1 without conflict years and 6.6 without 1997-98.
- **The maritime effect survives multiple-testing and placebo checks.** Holm-adjusted $p < 0.001$, the only one of 14 contrasts below 0.05; rotation placebo over 59 shifts of more than two years: rank $p = 0.017$, across all contrasts 0.017 (not covering the choice of the maritime/mainland split). Leave-one-event-out: −5.3% to −4.5%; 6-df spline trend −4.1%; LOESS trend −4.6%; 5-year blocks: interval −6.2% to −2.1%.
- **Strong onsets may matter more, but the evidence is thin.** Maritime production the year after a strong onset: −7.7% (-11.4% to −3.7%); extra effect over moderate onsets −4.1% (-8.8% to 0.2%), from 6 events. Not tested: a rebound above trend two years after onset.

4. What this means for policy

- **If the aim is to time imports or reserve releases,** the national data point, tentatively, to the harvests after the El Niño year in the maritime countries, not the onset year. National annual totals cannot show local losses and arrive too late to trigger early action; seasonal, subnational monitoring is the operational signal.
- **If reserves or insurance are sized on variation in typical years,** deep national shortfalls have come more often than that implies, but most of them before 1980, and a bell curve fitted to all years, bad ones included, is not rejected. Calibrating on all years matches the historical record; calibrating on recent decades matches current volatility. Larger buffers cost money in calm years; the choice is between that cost and the cost of a shortfall.
- **If the 2026-27 event behaves like past ones,** the 2027 harvests in Indonesia, the Philippines and Malaysia are where a national signal would show. The estimate averages 19 past events and cannot say how this stronger-than-most event will play out; FAOSTAT figures for 2027 appear in late 2028. After the 6 strong onsets since

1961, maritime production the year after averaged −7.7% against trend (interval −11.4% to −3.7%), but with so few events we cannot say strong events differ from moderate ones. Neither figure is a forecast for 2027.

5. Caveats

- **National annual totals say nothing about local losses, where food insecurity concentrates.** Prices and trade are outside our scope: in 2023, for example, India's ban on non-basmati white rice exports in July pushed world rice prices to a 15-year high (CGIAR). Beyond the Indonesian scale check above, we have not compared the production gaps with import or reserve volumes. The six countries are the region's main producers. Of them, only the Philippines is among the appeal's 22 priority countries (Arab News/AFP); Timor-Leste, also on that list, and Myanmar and Lao PDR are not covered. The results speak to national import and reserve timing, not to anticipatory action triggers, which rest on seasonal, subnational forecasts.
- **Timing is approximate.** FAO records harvests by calendar year while cropping seasons straddle years, so part of the year-after gap may be harvest moved between calendar years rather than lost; we have not checked for a rebound the year after. The planned test looked at the onset year, and its comparison group includes the years after each onset, which pulls it toward zero.
- **The maritime result comes from checks added after the pre-specified test came back null.** The region split and the one-year lag were not specified in advance, and the yield-only effect does not survive a correction for multiple testing (adjusted p = 0.068). The placebo tests and the alternative trends make chance and detrending less likely explanations, but it remains a pattern to test on future data. Tonnes are paddy (unmilled) rice, roughly 1.5 to 1.7 times the milled weight.
- **The intervals re-estimate each country's typical variation in every draw but treat its long-run trend as known,** so they are somewhat too narrow. The 2018 break in Indonesia's series is estimated over years that include two El Niño episodes, which if anything understates the Indonesian effect. The tonnes scale an average past event to an end-of-sample trend that is itself uncertain; they indicate magnitude, not a forecast for 2027.

References

- Naylor, R. et al. (2001). Using El Niño-Southern Oscillation climate data to predict rice production in Indonesia. *Climatic Change*. doi:10.1023/A:1010662115348
- Naylor, R. et al. (2007). Assessing risks of climate variability and climate change for Indonesian rice agriculture. *PNAS*. PMC1876519
- NOAA Climate Prediction Center (2026). ENSO diagnostic discussion, 12 November 2026. cpc.ncep.noaa.gov
- FAO and WFP (2026). Joint El Niño anticipatory action appeal; priority countries as reported by Arab News/AFP.
- CGIAR (2023). India's export restrictions on rice continue to disrupt global markets, supplies and prices. cgiar.org
- Statistics Indonesia (2025). Rice imports 2024, via CNBC Indonesia.

Data and code

- FAOSTAT Production: Crops and livestock products (QCL) (accessed 2026-11-20)
- NOAA CPC Oceanic Niño Index (ONI, ERSSTv5) (accessed 2026-11-20)
- UCDP/PRIO Armed Conflict Dataset (accessed 2026-11-20)
- Code: GitHub, Mithril-Metrics

Pietro Sala · Views are the authors' own. Mithril Metrics · mithril-metrics.github.io **Use of AI tools.** We use Claude, an AI assistant by Anthropic, as a working tool: to help with coding, data retrieval scripts and first drafts of text. Questions, methods, robustness checks and conclusions are our own, every number is reproducible from the published code, and we review all text before it goes online.