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Fire in the Horizon:
The Modeled Impacts of the 2026 Super El Niño on Indonesian Economy

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Abstract

Indonesia enters the 2026 dry season facing an emerging super El Niño whose economic consequences still lie largely ahead of it. This paper develops a calibrated system-dynamics model to trace how such a shock propagates through the economy in three successive waves: the direct, biophysical losses in rain-bound sectors; the indirect, pecuniary channels of price, health, demand, and public finance; and the macroeconomic indicators that record the cumulative toll. Simulated across the ENSO intensity range, the model's central finding is that the indirect wave exceeds the direct one — under a strong-to-super event the direct losses subtract on the order of 0.7 to 0.9 percent of GDP and the indirect channels a further 1.0 to 1.4 percent, so that the two together cost roughly 1.7 to 2.3 percent of GDP, while an accounting confined to scorched fields and failed harvests captures less than half the true toll. In the aggregate this shaves 0.5 to 0.7 points off growth, lifts inflation by 3.5 to 4.4 points, widens the fiscal deficit by about half a percentage point, stresses between 2.8 and 3.5 million agricultural livelihoods, and tips 1.1 to 1.5 million people below the poverty line. The aggregate hit is absorbable; its danger is distributional, falling on the food-heavy household budget, the informal farm job, and an already-stretched fiscal position. Policy cannot change the size of the shock but can substantially shape its incidence — through food-price stabilisation, adaptive social protection, fire prevention treated as macroeconomic policy, and prudent relief financing, all of which must be in place before the September–October peak. The reported figures are scenario outputs rather than forecasts; the model's contribution lies in revealing the structure of propagation and the points at which it can be interrupted.

Keywords: El Niño; ENSO; Indonesia; system dynamics; economic propagation; food prices; social protection; climate shock.

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In the opening months of 2026, before the dry season had fully arrived, fire had already consumed more than 42,000 hectares of Indonesian land — an area four times the size of Paris, or about the size of Jakarta, its capital — with the scale of burning by February running some twenty times higher than a year earlier.[1] The cause, scientists warned, was the early stirring of a so-called "Godzilla" El Niño: a warming of the Pacific Ocean of potentially historic force, which by mid-2026 forecasters judged near-certain to strengthen into a "strong," and quite possibly "very strong" episode before year's end.[2] For an archipelago whose rice fields, peatlands, and power grid all bend to the rhythm of the rains, such an event is no abstraction. Past super El Niños have scorched harvests and smothered cities in haze; the 1997–98 episode alone cut national rice production by as much as six percent, while the milder 2024 event erased roughly 2.3 million tonnes of output in a matter of months.[3] And as the planet warms, these once-in-a-generation shocks are arriving more often and striking harder, turning what was once a meteorological curiosity into a recurring test of the nation's food security, public health, and energy resilience.[4] It is against this backdrop — a climate growing less forgiving with each passing year — that the case for accelerating Indonesia's energy transition, and for the carbon-pricing instruments capable of financing it, becomes not merely an environmental aspiration but an economic imperative.

El Niño is a natural climate pattern that returns every few years, when a vast stretch of the Pacific Ocean along the equator turns unusually warm. That warmth shifts the world's wind and rainfall patterns, bringing drought to Indonesia and Southeast Asia while drenching parts of South America.[5] Most El Niños are mild, but the strongest ones — when the central Pacific warms by about 2 °C or more above normal — are powerful enough to disrupt weather across whole continents at once. These are the events people nickname "super" or "Godzilla" El Niños, the most famous being those of 1982–83, 1997–98 and 2015–16.[6] Scientists have found that these extreme events are becoming more common, and may strike about twice as often this century as they used to.[7] The 2026 El Niño looks set to join that group: in June 2026 forecasters confirmed it

[1] "Indonesia on alert for prolonged dry season as El Niño nears," *The Star / The Jakarta Post* (ANN), (April 12, 2026); "Indonesia braces for possible 'Godzilla El Niño' as fire season escalates early," *Mongabay*, (April 15, 2026.

[2] "Rising odds of a strong-to-historic El Niño event in 2026," *Weather West* (June 2026). About ≈88% odds of at least a "strong" event, >60% of "very strong"; the "Godzilla" framing per Erma Yulihastin at the National Research and Innovation Agency (Badan Riset dan Inovasi Nasional, BRIN), as cited in Siswadi, A., 2026. "BRIN Attributes Severe Dry Season Across Indonesia to Super El Nino and IOD+," *Tempo English*, (March 20, 2026).

[3] Jong, H.N., 2026. "'Godzilla El Niño' threat looms as Indonesia's fire season starts early," *Eco-Business*, (April 20, 2026).

[4] "Are we heading towards a Super El Niño in 2026?" *Zero Carbon Analytics* (April 2026). https://zerocarbon-analytics.org/insights/briefings/el-nino-and-climate-change/ (accessed on June 16, 2026).

[5] McPhaden, M.J., S.E. Zebiak, and M.H. Glantz, 2006. "ENSO as an Integrating Concept in Earth Science," *Science* 314, pp. 1740–1745; "Oceanic Niño Index (ONI): Historical El Niño/La Niña Episodes (1950–Present)", NOAA (National Oceanic and Atmospheric Administration/ National Weather Service, Climate Prediction Center). https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php (accessed Jun 18, 2026).

[6] The "very strong" class corresponds to an Oceanic Niño Index — the three-month running mean of Niño 3.4 anomalies — at or above about 2.0 °C; the 1982–83, 1997–98 and 2015–16 events each reached it., See NOAA, 2026, op. cit. Three-month running mean of SST anomalies in the Niño 3.4 region (5°N–5°S, 120°–170°W) against a centered 30-year base period updated every five years; NOAA's historical ENSO episode-and-strength table. The "Godzilla" label was applied to the 2015–16 event by the NASA Jet Propulsion Laboratory climatologist William Patzert and is colloquial rather than technical.

[7] Cai, W., S. Borlace, M. Lengaigne, P. van Rensch, M. Collins, G. Vecchi, A. Timmermann, A. Santoso, M.J. McPhaden, L. Wu, M.H. England, G. Wang, E. Guilyardi, and F.-F. Jin, 2014, "Increasing frequency of extreme El Niño events due to greenhouse warming," *Nature Climate Change*, 4 (2), pp. 111–116. Extreme events

had formed and would strengthen into the new year, with roughly a two-in-three chance of reaching the "very strong" category — possibly one of the most intense ever recorded.[8] How much of this owes to human-driven climate change is still debated, but the weight of recent evidence suggests a warming world is making El Niño's extremes fiercer, and the steadily rising ocean temperature adds to the heat of every event.[9]

El Niño won't hit Indonesia all at once — it will arrive as a slow, creeping drought. Two things drive it. First, the Pacific Ocean heats up and pulls the rain clouds eastward, away from Indonesia. Second, a separate ocean pattern called the Indian Ocean Dipole cools the sea just west of Sumatra and Java, shutting off the moisture that would normally blow in from that side.[10] The drying has already begun — by late May 2026, nearly 12 percent of the country had slipped into its dry season — and the national weather agency, BMKG, expects the worst of it in August, when almost half the country will be at its driest, before it eases in September and drags on into early 2027.[11] How strong will it get? Forecasters don't fully agree. BMKG's main view is "moderate to strong," putting the chance of at least a moderate El Niño at 98 percent and a strong one at 62 percent.[12] The U.S. weather agency NOAA thinks it could bite harder — giving roughly even odds of a "strong" event and a one-in-four chance of a "very strong" one.[13] And BRIN, Indonesia's research agency, goes furthest of all, calling it a "super" or "Godzilla" El Niño fed by unusually hot Pacific waters that could keep much of the country dry for up to six months, from April to October.[14]

Just how hot are those waters? An El Niño's strength is measured by how far the central Pacific climbs above its normal temperature: a rise of 0.5–1 °C is counted as weak, 1–1.5 °C as moderate, 1.5–2 °C as strong, and anything past 2 °C as "very strong" — the rare "super" class.[15] BRIN expects this year's event to push the Pacific roughly 1.5–2 °C above normal, placing it right on the strong-to-super line, and several forecasters note the ocean is warming faster now than it did at the same stage before the last two super events.[16] For perspective, the most powerful El Niños on record peaked at about 2.2 °C in 1982–83, 2.3–2.4 °C in 1997–98, and 2.6 °C in 2015–16 — the hottest ever

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roughly doubling in frequency, from about one in twenty to one in ten years; See also, on the trend toward more frequent "super" events, Wang, G., W. Cai, B. Gan, L. Wu, A. Santoso, X. Lin, Z. Chen, and M.J. McPhaden, 2017, "Continued increase of extreme El Niño frequency long after 1.5 °C warming stabilization," *Nature Climate Change*, 7 (8), pp. 568–572.

[8] "ENSO Diagnostic Discussion — El Niño Advisory", CPC (Climate Prediction Center, National Weather Service, NOAA), (11 June 2026). https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.shtml; WMO (World Meteorological Organization), 2026. El Niño/La Niña Update (May 2026). WMO (World Meteorological Organization), (June 2, 2026). https://wmo.int/resources/publication-series/el-ninola-nina-updates/el-ninola-nina-update-may-2026 (both accessed on June 16, 2026). The CPC put the probability of a very strong event (Niño 3.4 exceeding 2.0 °C) at about 63 percent for November–January.

[9] IPCC (Intergovernmental Panel on Climate Change), 2021. *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the IPCC*. Cambridge University Press, Cambridge and New York. The report shows robust, statistically significant projected increase in ENSO-related rainfall variability, against limited model consensus on changes in ENSO sea-surface-temperature amplitude.

[10] Siswadi, 2026, *op. cit*.

[11] "BMKG: August peak dry season calls for stronger preparedness amid El Niño risks," *Independent Observer*, (June 11, 2026).

[12] Zahro, A.A., 2026, "Puncak musim kemarau Agustus 2026, perkuat kesiapan hadapi dampak El Nino," Siaran Pers, BMKG (Badan Meteorologi, Klimatologi, dan Geofisika), (June 10, 2026). https://www.bmkg.go.id/siaran-pers/bmkg-puncak-musim-kemarau-agustus-2026-perkuat-kesiapan-hadapi-dampak-el-nino (accessed on June 20, 2026).

[13] Jong, H.N., 2026, "Indonesia braces for possible 'Godzilla El Niño' as fire season escalates early," *Mongabay*, (April 15, 2026).

[14] Ananda, R.P., 2026, "Indonesia faces six-month dry spell as 'Godzilla El Niño' looms," *Jakarta Globe*, (March 20, 2026).

[15] "El Niño on the horizon: can the warm phase end six years of drought in the Southern Plains of the U.S.?," *Drought.gov*, (March 11, 2026). https://www.drought.gov/news/el-nino-horizon-can-warm-phase-end-six-years-drought-southern-plains-us-2026-03-11 (accessed on June 18, 2026).

[16] *ibid*; "Could the upcoming super El Niño be the strongest ever?," *OpenSnow*, (June 2026).

measured.[17] A word on 'strongest': the label refers less to a record-breaking peak than to real-world severity. This El Niño is building faster than recent super events and arriving on an already-hotter planet alongside a second drying force, so the drought and heat it brings could be the worst in decades even if the Pacific itself never sets a temperature record. It sounds modest, but the central Pacific only has to run two or three degrees above its usual temperature to throw weather across much of the planet into disarray.

The damage in Indonesia comes in two waves. The first, direct hit falls on everything tied to rain and fire: rice and other food crops lose yield or fail, plantations like palm oil, coffee, and cocoa come under water stress and burn, fish catches shift as seas warm, forests go up in flames, and reservoirs and rivers run low — squeezing water supply and hydropower. In the last big El Niño, in 2023, this chain cut Indonesia's rice harvest by about 1.2 million tonnes against a 30-million-tonne target, and rice became the single biggest driver of inflation that year.[18] The second, indirect wave then spreads through prices and disruption: costlier crops push up food prices, eroding household spending and hitting poorer families hardest; factories face higher cooling demand and water limits; low rivers snarl the barges that haul coal and commodities; haze from the fires sickens people and deters tourists; and the government's bill climbs as it imports rice and pays out subsidies, cash aid, and disaster relief. The reason a failed harvest echoes so loudly is structural: farming is about 13 percent of GDP and close to a third of all jobs, while food is the heaviest single category in the price basket — and the volatile-food and government-set prices most exposed to shocks together make up roughly 40 percent of the index, which is what turns a crop shortfall into economy-wide inflation.[19] The strain is already visible this year: by February 2026, fires had burned 32,637 hectares, about twenty times the area lost in the same period of 2025.[20] In short, the drought begins in the fields but ends up in shopping baskets, hospitals, and the national budget.

2 The Propagation of the Impacts Throughout the Economy

2.1 Indonesia’s Current Economic Challenges

Indonesia's economy presents, in mid-2026, a study in contradiction. By the headline measure it has rarely looked stronger — output grew 5.6 percent year-on-year in the first quarter, the briskest pace since 2021 — yet that growth was borrowed as much as earned, resting on holiday spending and front-loaded fiscal stimulus rather than a durable widening of a productive base whose potential the World Bank places nearer 4.2 percent, and which it expects to ease back toward 5.0 percent across the year.[21] The markets that price the country in real time have rendered an almost opposite verdict. The rupiah breached eighteen thousand to the dollar for the first time in its history in early June, Asia's worst-performing currency for the year and down roughly nine percent over

[17] Becker, E., 2023, "December 2023 El Niño update: adventure!," *NOAA Climate.gov*, (December 13, 2023). https://www.climate.gov/news-features/blogs/enso/december-2023-el-nino-update-adventure (accessed on June 17, 2026).
[18] Putri, R.S., 2023. "Indonesia loses 1.2M tonnes of rice over El Nino, agriculture minister says," *Tempo English*, (August 31, 2023); Aona, W., N.F. Ramadhani, 2023. "Roundup: Indonesia's rice production disrupted by El Nino, raising inflation," *Xinhua*, (November 5, 2023).
[19] "Agriculture, forestry, and fishing, value added (% of GDP) – Indonesia," *World Bank*, https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=ID; "Employment in agriculture (% of total employment) (modeled ILO estimate) – Indonesia," *World Bank*, https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=ID; "Inflation," *Bank Indonesia*, https://www.bi.go.id/en/fungsi-utama/moneter/inflasi/default.aspx (all accessed on June 18, 2026).
[20] Jong, H.N., 2026, "Indonesia braces for possible 'Godzilla El Niño' as fire season escalates early," *Mongabay*, (April 15, 2026).
[21] World Bank, 2026, *Indonesia Economic Prospects, June 2026 — Managing Risks, Unlocking Productivity*, World Bank, Jakarta, (June 2026). https://www.worldbank.org/iep (accessed on June 18, 2026). Q1 growth and potential/projected growth (pp. 1–2, 7, 20); fuel-price measures (p. 8); fiscal position and subsidy loop (pp. 16–17); labor and middle-class-worker data (pp. 2, 14–15).

twelve months, while the Jakarta Composite Index (Index Harga Saham Gabungan, IHSG) has shed about a third of its value in 2026 — a five-year low, and the worst performer among more than ninety global indices — battered by the oil shock from the war on Iran, a trade surplus that collapsed from US$3.3 billion in March to US$89 million in April, and a crisis of market confidence that began with threat from Morgan Stanley Capital International (MSCI) to downgrade Indonesia to frontier status and forced the resignations of the stock exchange and markets-regulator chiefs.[22] Bank Indonesia has raised rates to 5.25 percent — its first hike in two years — and spent reserves down to a near two-year low, yet the slide has proved difficult to arrest.[23]

The strain runs deeper than asset prices. Headline inflation, having fallen to an April low, re-accelerated to 3.1 percent in May, with food inflation jumping to 4.9 percent, its highest since October; though still within Bank Indonesia's target band, the upturn is driven by the very channels most exposed to external shock, as a weaker rupiah feeds imported costs and the government, unable to absorb dearer oil, has lifted non-subsidized fuel prices by an average of some sixty-four percent since April.[24] Fiscal space has narrowed in step — the tax take fell to a record-low 9.3 percent of GDP in 2025, borrowing costs have risen as demand for government bonds thins, and a self-reinforcing subsidy loop (a weaker rupiah swelling the import-linked subsidy bill, widening the deficit, pressuring the currency anew) has fed talk of a broad "sell Indonesia" trade.[25] And beneath it all, even strong growth has not arrested the erosion of the middle class: the share of workers earning a middle-class income has fallen from 14.5 percent in 2018 to barely 7 percent in 2025, while independent estimates record the middle class itself shrinking from 47.9 million people in 2024 to 46.7 million in 2025, with consumer confidence at its lowest since September 2025.[26]

It is onto this terrain — a currency at record lows, markets unsettled, fiscal buffers thinned, and a middle class quietly hollowing — that the climatic shock of the preceding section now threatens to fall. The channels through which a super El Niño does its damage are precisely those along which Indonesia is already most exposed: a failed harvest feeds the volatile-food prices that have only just begun to climb again; drought-driven rice imports and relief outlays draw on a budget with little slack and a currency punished by every additional dollar of imports; and dearer food and fuel fall heaviest on the very households whose welfare has been eroding for a decade. Tellingly, the danger was being named aloud well before the drought arrived: investment banks surveying 2026 flagged weather-related disruption as a principal threat to food prices, and Bank Indonesia itself — citing the seasonality of horticultural crops and an intensifying climate — made the anticipation of extreme-weather risk an explicit pillar of its 2026 food-inflation strategy.[27]

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[22] "Indonesia's rupiah falls to record low against US dollar," *Al Jazeera*, (June 4, 2026); "Indonesian Rupiah," *Trading Economics*, (June 17, 2026). https://tradingeconomics.com/indonesia/currency (accessed on June 18, 2026); Juwita, R.D., 2026. "Rupiah slides to record 18,000 low, 2026 losses deepen," *The Jakarta Post*, (June 4, 2026); Toh, B., and P. Wirayani, 2026. "Indonesian stocks slump to five-year low, rupiah drops to record," *The Edge Malaysia*, (June 4, 2026); "IHSG Plunge Explained: What Happened, Why It Matters, and What Followed," *Tempo English*, (January 31, 2026).

[23] *Trading Economics*, (June 17, 2026), *op. cit*.

[24] World Bank, 2026, *op. cit*; *Trading Economics*, (June 17, 2026), *op. cit*. https://tradingeconomics.com/indonesia/inflation-cpi (accessed on June 18, 2026).

[25] World Bank, 2026, *op. cit*.; Juwita, 2026, *op. cit*.

[26] World Bank, 2026, *op. cit*.; *Trading Economics* (June 17, 2026); Nugroho, A., 2026. "UGM Economist Warns of Growing Vulnerability as Indonesia's Middle Class Declines," Universitas Gadjah Mada, (February 27, 2026). https://ugm.ac.id/en/news/ugm-economist-warns-of-growing-vulnerability-as-indonesias-middle-class-declines/ (accessed on June 18, 2026).

[27] Hamdhi, A., 2026. "Bank Indonesia Strengthens Food Price Controls Ahead of Ramadan 2026," *Jakarta Globe*, (February 16, 2026), quoting Bank Indonesia Deputy Governor Ricky P. Gozali; see also Julikawati, P.E., 2026. "Indonesia's Central Bank Strategies to Curb Food Inflation Amid Climate Risks," *Tempo English*, (February 11, 2026).

The state itself, meanwhile, meets these pressures with a budget already stretched by ambition: President Prabowo's first full fiscal program commits unusually large sums to a roster of strategic projects and priority initiatives — chief among them the free-nutritious-meals scheme, originally budgeted at Rp335 trillion, or roughly a tenth of central-government spending, before a mid-year trimming to Rp268 trillion, alongside major food- and energy-security outlays, a three-million-homes drive, and the new Danantara investment vehicle — financed by an aggressive use of fiscal space that regional analysts have tied directly to widening deficit pressure and the acceleration of strategic infrastructure projects.[28]

Onto that crowded ledger then fell the bill for catastrophe: the Cyclone Senyar floods and landslides that devastated Aceh, North Sumatra, and West Sumatra in late November 2025 — among the deadliest disasters in the nation's modern history, claiming more than eleven hundred lives — whose reconstruction the government initially costed at upward of Rp51 trillion (some US$3.1 billion), and independent researchers at as much as Rp77 trillion, already exceeding the roughly Rp60 trillion the central government had set aside for recovery, while the latest government budget for recovery already reaches more than Rp100 trillion.[29]

2.2 The Impacts of the Super El Nino on Key Economic Sectors

The heat from the super El Nino will propagate throughout the entire economy through many channels and means. The natural place to begin is the point of impact. Before a single price moves or a rupiah of subsidy is paid, the heat and the drought fall upon a narrow set of sectors whose output answers directly to rainfall, temperature, and fire — the front line of what was earlier called the first wave. The table below identifies those directly exposed sectors, together with the specific channel by which El Niño reaches each; the slower, wider consequences that radiate outward from them are taken up in the discussion that follows.

[28] On the scale and budgetary weight of the priority programs: "Indonesia cuts MBG budget by Rp67 trillion in 2026 APBN," *Antara News*, (May 19, 2026); Isaac, J., 2026. "Prabowo stands firm on free meals program amid fiscal pressures," *Indonesia Business Post*, (March 18, 2026). On strategic-infrastructure and priority-program spending as a driver of deficit pressure, Isaac, J., 2025. "Free nutritious meals program hits only 7 percent budget use amid fiscal deficit concerns," *Indonesia Business Post*, (July 2, 2025), reporting the ASEAN+3 Macroeconomic Research Office (AMRO) 2025 Annual Consultation Report.

[29] "Indonesia says more than $3 billion in recovery funds required after Sumatra floods," *Reuters*, (December 8, 2025); "Research Warns Sumatra Reconstruction Could Cost Rp77 Trillion, Far Above Gov't Budget," *Jakarta Globe*, (December 29, 2025), reporting the Center of Reform on Economics (CORE) and BNPB data; and World Bank, 2026, *op. cit*., p. 16, on the additional transfers required for the affected provinces. The latest assessment as presented in the latest, final Master Plan, is that the government may require more than Rp100 trillion (about $5.5 billion at Rp18,000 for $1). See Bappenas (Ministry of National Development Planning), 2026. *Rencana Induk Percepatan Rehabilitasi dan Rekonstruksi Pascabencana Alam di Wilayah Provinsi Aceh, Provinsi Sumatera Utara, dan Provinsi Sumatera Barat* (April 2026). Ministry of National Development Planning, Jakarta,

Sector	Dominant Channel	Principal Direct Effect
Food crops (rice, maize, soybean)	Drought; late, weakened monsoon	Delayed planting, lower yields, and outright harvest failure — the 1997–98 super event cut national rice output by as much as 6 percent, and the milder 2023–24 episode erased on the order of 1–2 million tons.
Estate crops (palm oil, coffee, cocoa, rubber)	Water stress and heat, with a 6–12-month lag; fire	Reduced fresh-fruit-bunch and bean yields months after the drought itself; the 2015–16 event lowered Indonesian crude-palm-oil output by an estimated 5–10 percent the following year.
Capture fisheries & aquaculture	Warmer seas, shifted upwelling and currents	Lower and displaced catches and added stress on coastal ponds — in a sector that contributes roughly 2.6 percent of GDP and supports more than 7 million livelihoods.
Forestry, land & peatland	Drought-primed fire; peat combustion	Loss of forest and standing crops, carbon emissions, and choking haze — the 2015 fires burned some 2.6 million hectares at an estimated cost of US$16 billion, near 1.9 percent of GDP.
Water resources & hydropower	Falling reservoir levels and river flow	Irrigation shortfalls, reduced hydroelectric generation, and urban water stress, with mining and water-intensive manufacturing among the exposed.
Inland river transport (coal, bulk commodities)	Declining river depth	Stranded or part-laden barges on arteries such as the Barito and Mahakam, delayed shipments, and higher logistics costs.

Table 2.1. The first wave: sectors directly exposed to El Niño's drought, heat, and fire.

The first wave's logic is straightforward, though its timing is uneven. Food crops feel the drought almost at once, as a late or failed monsoon delays planting and shrivels what is already in the ground; estate crops respond more slowly, the water stress of one dry season expressing itself in diminished yields six months to a year later, which is why the 2015–16 drought registered in the palm-oil figures only in 2016.[30] Fisheries shift as the seas warm and the currents move, while the forestry sector suffers the most spectacular and far-reaching blow of all: where drought meets Indonesia's drained peatlands, the land itself becomes fuel, and the fires that follow — burning underground for weeks, beyond the reach of water — produce not only the loss of forest and crop but the transboundary haze whose costs the World Bank put, for 2015 alone, at some US$16 billion.[31] Beneath all of these runs water as the connective tissue: the same drought that starves the paddy and the plantation also lowers the reservoirs that turn the turbines and the rivers that float the barges, so that a single meteorological shock is transmitted simultaneously into food, energy, and freight.[32]

[30] "Palm Oil Indonesia: After Dry El Niño, Will Wet La Niña Impact CPO Output?," *Indonesia Investments*, (April 27, 2016), reporting an estimated 5–10 percent 2016 output decline; "Industry Outlook 2025–2027: Palm Oil Industry," *Krungsri Research*, (March 21, 2025), on per-unit yield reductions of 0.5–1.5 percent in a drought year; "El Niño expected to have minimal impact on palm oil production," *The Edge Malaysia*, (December 28, 2023), on the 6–12-month lag between drought and fruit production.

[31] World Bank, 2016, *The Cost of Fire: An Economic Analysis of Indonesia's 2015 Fire Crisis*, World Bank, Jakarta, as reported in "Haze price tag, $16B: Fires cost Indonesia twice the tsunami bill," *Rappler*, (October 27, 2015); on the 1997–98 (≈8 million hectares) and 2019 (≈US$5.2 billion) events, see Kiely, L., et al., 2021, "Assessing costs of Indonesian fires and the benefits of restoring peatland," *Nature Communications*, 12.

[32] "The Impacts of El Niño Go Far Beyond Water," WRI (World Resources Institute), (May 2, 2024). https://www.wri.org/insights/impacts-el-nino-beyond-water (accessed on June 18, 2026); Mante, L., 2026. "Impacts of an Impending 'Super' El-Niño on Global Supply Chains," *ORF Middle East*, (May 11, 2026), on hydropower-dependent mining; Ang, A., 2026, "Asia is already grappling with a fuel crisis. A 'Super El Nino' threatens to make things worse," *Fortune*, (May 28, 2026). On strained electricity supply and water-intensive manufacturing; Asian Development Bank, 2016, *Indonesia: Country Water Assessment*. Asian Development Bank, Manila.

Channel	Transmission Mechanism	Principal Indirect Effect
Consumer prices	Failed harvests and costlier food imports pass through to the price level	Higher headline inflation, led by volatile food — the volatile-food and administered prices most exposed to weather are together roughly two-fifths of the CPI.
Household welfare & demand	Food and fuel claim the largest budget share of poorer households	Eroded real purchasing power, softer consumption, and heightened risk of slippage into poverty for the near-poor.
Public health	Peat- and forest-fire haze (fine particulates) across Sumatra and Kalimantan	Respiratory illness and excess mortality — the 2015 haze was tied to tens of thousands of premature deaths — alongside school and workplace closures.
Tourism & hospitality	Haze, air-quality alerts, and flight disruption	Cancelled trips, lower arrivals and hotel occupancy, and lost services revenue across affected regions.
Trade, logistics & exports	Low river levels and freight friction on commodity arteries	Delayed and costlier coal and bulk shipments, softer export earnings, and higher domestic freight costs.
Energy & water-intensive industry	Reduced hydropower, heat-driven cooling demand, and water rationing	Higher, more fossil-reliant generation costs and constrained output in cooling- and water-intensive manufacturing.
Public finances & external balance	Rice and food imports, larger subsidies and disaster relief, and weaker rural revenue	A wider fiscal deficit that crowds out priority spending, and a heavier import bill that widens the current-account gap and presses on the Rupiah.

Table 2.2. The second wave: indirect channels through which El Niño's losses propagate.

The master channel of the second wave is the price level. Because food, beverages, and tobacco alone account for roughly a quarter of Indonesia's consumer basket, and because the volatile-food and administered-price components most exposed to weather together make up close to two-fifths of the index, a poor harvest does not remain a rural event — it is transmitted almost mechanically into headline inflation. That transmission is regressive in its incidence: poorer and newly precarious households devote the largest share of their budgets to food and fuel, so the same price increase that is a mild inconvenience to the comfortable is, for them, a direct erosion of real income — and, in the aggregate, a drag on the very household consumption that carries more than half the economy. What begins as a supply shock in the fields, in other words, becomes a demand problem in the cities, as squeezed households defer purchases and trade down, and as the near-poor slip back across a threshold many had only recently managed to cross.[33]

Where the drought has tipped over into fire, a second and more insidious channel opens. The haze that rises from burning peat and forest is not merely an environmental nuisance but a public-health emergency: the fine particulate matter it carries settles into the lungs of tens of millions, driving respiratory illness and, in the severe episodes, tens of thousands of premature deaths, while schools and workplaces close and outdoor labor halts. The economic ledger of fire, as the World Bank's accounting of the 2015 crisis made plain, runs well beyond the forestry sector itself — into trade, transportation, manufacturing, and, conspicuously, tourism, as air-quality alerts, cancelled flights, and shuttered attractions empty the hotels and divert the visitors on whom whole regional economies depend. Nor is the damage contained within national borders: the smoke drifts across the straits into Malaysia and Singapore, turning a domestic misfortune into a

[33] World Bank, 2026, *op. cit.*, on subsidy and disaster-relief outlays, rice and food imports, and the import-sensitivity of the budget and the current account; see also the currency analysis in the preceding subsection.

regional and diplomatic one — a cost the headline figures, confined to Indonesia, do not even capture.[34]

The same drought that feeds the fires also lowers the water on which a surprising share of the economy floats. River-based transportation and logistics, for example for timber and coal, among others, may experience some choking situations that delay shipments to port and raising logistics costs, and, with them, the local employment and income. Upstream of the turbines the logic repeats: reduced river flow and falling reservoirs curtail hydroelectric generation, pushing the system toward costlier and more fossil-reliant substitutes — and threatening the hydropower on which Indonesia's nickel smelting and broader mining operations depend — at the very moment that heat drives cooling demand higher and water rationing constrains the water-intensive manufacturing, from semiconductors to textiles, that needs reliable power and water alike. Because agriculture already claims the overwhelming majority of the nation's water, a dry year forces exactly the competition between farm, factory, city, and power station that the water–food–energy nexus describes — a contest in which something must give.[35]

All of these channels eventually converge on the public accounts. Confronted with a failing harvest, the state must spend more even as it collects less: it imports rice and other staples to cover the shortfall, widens subsidies and cash assistance to cushion households, and pays out disaster relief where fire and drought have done their worst, all while revenue from a slowing rural economy softens. The result is a deficit pressed wider at the very moment when, as the preceding section showed, there is little room left to absorb it — and every additional tonne of imported food and fuel must be settled in dollars, enlarging the import bill, widening the current-account gap, and adding to the pressure on a rupiah already at record lows. The drought, in this final reckoning, does not merely raise prices and sicken populations; it reaches into the exchange rate and the budget themselves, closing the loop between a shock that begins in the fields and the macroeconomic fragility traced in the section before.[36]

What turns a weather event into a macroeconomic one, in the end, is structure. Agriculture remains close to a tenth of Indonesia's output and employs roughly a third of its workforce, so a poor harvest is felt not only in prices but in incomes and demand across vast rural regions; and because the channels of transmission — food inflation, fiscal outlay, currency-sensitive imports, household fragility — are precisely those along which the economy was already under strain, the El Niño shock does not simply add to the burden but compounds it.[37] It is this compounding, rather than any single sectoral loss, that the modeling in the sections that follow is designed to trace: not merely how much rice or palm oil or hydropower a drought might cost, but how those first-wave losses move through prices, budgets, and balance sheets to shape the trajectory of the economy as a whole.

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[34] World Bank, 2016, *op. cit.*, on losses to trade, transportation, manufacturing, tourism, and health and the transboundary reach of the haze; and Kiely, L., et al., 2021, "Assessing costs of Indonesian fires and the benefits of restoring peatland," *Nature Communications*, 12, on fire-haze mortality.
[35] World Resources Institute, "The Impacts of El Niño Go Far Beyond Water," (May 2, 2024). https://www.wri.org/insights/impacts-el-nino-beyond-water (accessed on June 18, 2026); "Impacts of an Impending 'Super' El-Niño on Global Supply Chains," *ORF Middle East*, (May 11, 2026). https://orfme.org/expert-speak/impacts-of-an-impending-super-el-nino-on-global-supply-chains/ (accessed on June 18, 2026); Ang, A., 2026, "Asia is already grappling with a fuel crisis. A 'Super El Nino' threatens to make things worse," *Fortune*, (May 28, 2026); Asian Development Bank, 2016, *Indonesia: Country Water Assessment*, Asian Development Bank, Manila. https://www.adb.org/documents/indonesia-country-water-assessment (accessed on June 18, 2026).
[36] World Bank, 2026, *op. cit.*, on subsidy and disaster-relief outlays, rice and food imports, and the import-sensitivity of the budget and the current account; see also the currency analysis in the preceding subsection.
[37] World Bank, 2026, *op. cit*. (agriculture's share of output and employment; the food weight in the CPI); and Jong, 2026, *op. cit.*, for the 1997–98 (~6 percent) and 2024 (~2.3 million tonnes) rice losses.

The preceding two tables above took the shock apart; the one below reassembles it, showing how the scattered sectoral losses and propagating channels add up, in the aggregate, to movements in the indicators by which an economy is finally judged — growth, prices, the public budget, employment, and poverty. In each case the answer is governed by two things at once: the severity of the El Niño itself, which the modeling that follows will parameterize, and the fragility of the baseline onto which it falls, which the opening section has already established. What follows is the qualitative logic of those aggregate effects; the magnitudes are the work of the model.

Indicator	Transmission to the Indicator	Principal Macroeconomic Effect
Economic growth	Lost agricultural value-added, plus the second-wave drag on consumption, industry, and exports.	A net subtraction from output — the IMF finds El Niño lowers Indonesian activity, and cumulative losses are put at roughly 13 percent of GDP per capita since the early 1990s.
Inflation	Failed harvests and costlier food and energy imports passing through a food-heavy consumer basket.	Higher headline inflation — an El Niño shock lifts commodity-price inflation by some 3.5–4 percentage points, and rice was the single largest driver of Indonesia's 2023 inflation.
Government budget	Rice imports, wider subsidies and cash transfers, and disaster relief set against softer rural revenue.	A deficit pushed wider on a budget with little slack, and a heavier dollar import bill that widens the current-account gap and presses on the Rupiah.
Employment	Crop failure eroding incomes in a sector that still provides close to a third of all jobs	Less open unemployment than deteriorating job quality — rising informality and underemployment, and reverse migration onto the land, as in 1997–98.
Poverty & welfare	Rice-price spikes cutting real consumption hardest for low-income and near-poor households	Vulnerable households tipped back below the poverty line — in 1997–98 the rate climbed from about 11 to nearly 18 percent in two years, reversing hard-won gains.

Table 2.3. The macroeconomic reckoning: how El Niño's losses register in the headline indicators.

Begin with growth, where the cross-country evidence is consistent in its verdict: for Indonesia, El Niño is a subtraction rather than an addition. The International Monetary Fund's (IMF) standard study of the phenomenon finds that, while a handful of economies are lifted by an El Niño, Indonesia belongs to the group whose activity is reduced by it, and more recent work by researchers at Nanyang Technological University and the City University of Hong Kong estimates that Indonesia has borne the heaviest burden in Southeast Asia — a cumulative loss of roughly 13 percent of GDP per capita by 2023 relative to a world without the El Niño events of the preceding three decades.[38] The mechanism is the one the tables describe: with agriculture close to a tenth of output, a failed harvest subtracts directly from value added, while the second-wave drag on consumption, industry, and exports compounds the loss — and it lands, in 2026, on an economy already expected to decelerate from its brisk first-quarter pace toward a slower underlying trend.[39]

The clearest and most immediate signature is in prices. The same IMF study finds that an El Niño shock raises real commodity-price inflation by some 3.5 to 4 percentage points, with food and energy among the most affected — inflation that Indonesia, as a net importer of both, imports along with the goods.[40] Domestically, the transmission runs through rice above all: in the 2023 episode a prolonged dry season cut paddy output by close to a fifth in affected regions, rice became the single largest contributor to that

[38] Cashin, P., K. Mohaddes, and M. Raissi, 2017, "Fair weather or foul? The macroeconomic effects of El Niño," *Journal of International Economics*, 106, pp. 37–54; "The Economics of El Niño," *The Actuary*, (August 6, 2025), reporting research by Nanyang Technological University and the City University of Hong Kong; on the multi-trillion-dollar global losses of past super events, see also Ang, A., 2026, *op. cit*.
[39] Cashin, et al., 2017, *op. cit*.
[40] *ibid*.

year's inflation, and the government was driven to import as much as five million tonnes the following year.[41] Because food carries so heavy a weight in the consumer basket, and because monetary policy is largely powerless against a supply shock, a drought passes with little friction into headline inflation — precisely the channel Bank Indonesia singled out, ahead of the season, as its principal price risk for the year.

The fiscal consequences follow directly. To shield households and steady supply, the state buys and distributes rice, widens subsidies and cash transfers, and funds relief in the worst-hit regions, all while a slowing rural economy yields less revenue — a deficit pressed wider from both sides at once.[42] And because the additional staples and fuel must be paid for in dollars, the response feeds back into the import bill, the current account, and the exchange rate. On the budget described in the opening section — its strategic-project commitments, its record-low tax take, its fresh disaster bill — there is little slack to absorb any of this, so the drought competes directly for resources the government has already promised elsewhere.[43]

Employment absorbs the shock in a distinctive way. Agriculture still provides close to a third of all Indonesian jobs, so a poor harvest is, in the first instance, a loss of rural income — crop failure that erodes earnings and pushes smallholders toward debt. Yet the labor-market response is rarely a clean rise in open unemployment, for Indonesia has little in the way of unemployment insurance; instead, as the drought-and-crisis of 1997–98 demonstrated, the distress shows up in the quality of work — a swelling of informal employment and underemployment, and even a reverse migration as displaced urban workers fall back onto the land.[44] The headline jobless rate may barely move; the erosion happens beneath it.

It is in poverty, finally, that the shock comes to rest. The arithmetic is unforgiving: poorer households spend the largest share of their income on food, so a rice-price spike is for them an immediate cut in real consumption — and for the tens of millions clustered just above the poverty line, the aspiring-middle stratum traced in the opening section, it can be enough to tip them back below it. The historical precedent is sobering: during the El Niño drought that preceded the 1997–98 crisis, food prices multiplied and the national poverty rate rose from around 11 percent to nearly 18 percent within two years.[45] No one anticipates a repeat of that magnitude, but the direction is not in doubt, and it runs precisely counter to the decade-long erosion of the middle class already under way. The drought, in short, does not merely slow the economy; it redistributes its pain downward, toward those least able to bear it — and quantifying how far, and how fast, is the task to which the modeling now turns.

Taken together, these accounts follow one shock through three registers of the same economy: it begins narrowly, in the sectors bound to rain and fire; widens, through prices, health, and the public purse, into a second wave that reaches households far from any drought; and settles, at last, into the aggregate ledger as slower growth, dearer food, a wider deficit, frailer work, and deepened poverty. What makes the sum greater than its parts is the ground on which it falls — an economy whose currency, budget, and middle class were already strained, so that each of El Niño's channels runs along a

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[41] "As El Niño bites, Indonesians struggle with record-high rice prices," *The Jakarta Post*, (April 1, 2024); and "In rice-hungry Indonesia, El Niño-fuelled price hikes spark fears of food insecurity and unrest," *South China Morning Post*, (April 1, 2024), on the 2023–24 production shortfall, price spike, and rice imports.
[42] *ibid*.; World Bank, 2026, *op. cit*.
[43] World Bank, 2026, *op. cit*.
[44] *ibid*.; "Special Report: Indonesia," FAO (Food and Agriculture Organization of the United Nations), (January 18, 2000). https://www.fao.org/4/x4307e/x4307e00.htm (accessed on June 18, 2026).
[45] Soekirman, S., 2001. "Food and nutrition security and the economic crisis in Indonesia," *Asia Pacific Journal of Clinical Nutrition* 10 (1), pp. 57-61, on food-price escalation and the rise in poverty during the 1997–98 El Niño and crisis; on the contemporary vulnerable population just above the poverty line, see the middle-class and poverty data in the preceding section.

fault line opened before the first cloud failed to form. The drought does not merely visit a fresh misfortune upon Indonesia; it presses hardest on the very points where the country is least able to resist — and how hard it presses is a question that narrative can frame but only a model can answer.

3 Simulating the Impacts

3.1 Where We Are: The Indicators by Mid-June 2026

Any account of El Niño's economic toll written in June 2026 is written from inside the event rather than after it. The shock has not yet peaked — the dry season is only weeks old, and the historical pattern places the worst of the drought and fire between August and October.[46] What the data already show, then, is not the full reckoning but its leading edge: a first wave that is plainly registering, a second wave that has only begun to move, and a set of macroeconomic indicators that remain, for now, close to the robust baseline Indonesia carried into the year. The three tables below take a snapshot of each register at this moment, and the narratives read them in turn.

3.1.1 The First Wave: Already Visible

The direct, biophysical channels are the first to speak, and several are already speaking clearly. The sharpest signal is in rice. Statistics Indonesia (BPS) reports that rice production for consumption in April 2026 was 4.40 million tonnes — down 16.0 percent from a year earlier — with the paddy harvested area off by 15.5 percent, as an early, weakened wet season hit the planting cycle in Java's northern rice belt.[47] Palm oil tells a slower-moving version of the same story: 2025 output reached a record 51.66 million tonnes, but the industry now warns of a one-to-two-million-tonne loss in 2026 as drought combines with fertiliser costs that have climbed 30–50 percent on the back of the Middle East conflict — though, because fruit responds to water stress with a six-to-twelve-month lag, the deeper yield damage is expected to fall in 2027.[48]

Fire is the most dramatic reading of all: roughly 42,000 hectares had burned by the end of the first quarter, with the February burned area running about twenty times the level of a year earlier, and more than 23,000 peatland hotspots logged since January — all this *before* the dry season's peak.[49] The water, hydropower, and river-transport channels are not yet stressed, but the machinery of mitigation is already moving: the Public Works ministry is optimising reservoir releases to protect irrigation through a dry season now expected to run into December.[50]

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[46] Situmorang, H.D., 2026. "Indonesia's dry season may start early in 2026, peak in August: BMKG," *Jakarta Globe*, (March 4, 2026); Jong, 2026, *op. cit*.
[47] "Paddy Harvested Area and Production in Indonesia (Based on ASF Observation in April 2026)", *Official Statistics News*, BPS, No. 59/06/Th. XXIX (June 2, 2026).
[48] Teles, C., 2026. "Indonesia warns that palm oil production could fall by up to 2 million tons in 2026," *Click Oil & Gas*, (April 29, 2026), reporting ASPEKPIR on the 1–2 Mt warning and 30–50 percent fertiliser rise; USDA (United States Department of Agriculture, Foreign Agricultural Service), 2026, *Oilseeds and Products Annual: Indonesia*, GAIN (Global Agriculture Information Network) Report ID2026-0013, (April 15, 2026), on the drought outlook for palm regions.
[49] Jong, 2026, *op. cit*.; *The Jakarta Post*, (April 12, 2026), *op. cit*., for the ~42,000-hectare first-quarter figure from the Forestry Ministry.
[50] "Facing long drought 2026, the Ministry of PU optimizes Gajah Mungkur reservoir to maintain water availability," *Voice of Indonesia*, (April 6, 2026); *Jakarta Globe*, (March 4, 2026), *op. cit*.

Indicator (first wave)	Where It Stands Now (mid-2026)	Direction
Food crops (rice)	Rice-for-consumption output –16.0% y/y in April; paddy harvested area –15.5%; early drought in Java's northern belt.	Falling, deepening into the dry season.
Estate crops (palm oil)	2025 a record 51.66 Mt (+7.3%); industry warns of a 1–2 Mt loss in 2026 from drought + fertiliser costs up 30–50%; main yield hit lags to 2027.	Early; lagged risk building.
Fisheries	Fresh fish among the largest contributors to May food inflation; catch and pond disruption a developing risk.	Early price signal.
Forestry & peatland (fire/haze)	~42,000 ha burned by end-Q1; February burned area ~20× a year earlier; 23,000+ peatland hotspots since January; peak due Sept–Oct.	Rising sharply, ahead of peak.
Water & hydropower	Dry season early (onset Apr–Jun, peak ~Aug, lasting to ~Dec); reservoirs being managed to protect irrigation; shortfalls expected as drawdown deepens.	Mitigation underway; stress ahead.
River transport	Rivers near-normal after a wet early 2026; low-water disruption to Barito/Mahakam coal barges remains a forward risk, not yet realised.	Latent.

Table 3.1. The first wave at mid-2026: where the direct, biophysical channels stand.

The pattern across the table is consistent. Where the channel responds quickly to rainfall — rice, fire — the damage is already in the numbers. Where it responds with a lag — palm oil, hydropower, the rivers — the readings are still benign, but the conditions that produce the loss are visibly assembling. The first wave, in short, has arrived; it has simply not finished arriving.

3.1.2 The Second Wave: Just Beginning To Move

The indirect, pecuniary channels carry the first wave's losses outward, and the earliest of them is price. Headline inflation reached 3.08 percent in May 2026, still inside Bank Indonesia's 2.5 percent ±1 percent target band, but the food, beverage, and tobacco group rose 4.94 percent — its fastest pace since October — led by rice, fresh fish, cooking oil, and chillies.[51] This is, so far, a supply-side rather than a demand-side story: core inflation sits at a moderate 2.59 percent, and economists read the pickup as the leading edge of a shock that has not yet broadened, with the weaker rupiah's pass-through to import prices expected to land in June or July.[52] The household, health, tourism, and trade channels remain, for the moment, largely intact. Consumption was still firm in the first quarter, foreign tourist arrivals were running nearly 10 percent ahead of a year earlier, and the trade account held a surplus.[53] The exposure, rather than the damage, is what stands out: with food accounting for roughly three-quarters of the basket that defines the poverty line, the price channel is precisely the one to which Indonesia's near-poor are most vulnerable as the harvest shortfall feeds through.[54]

[51] "Series of Consumer Price Index May 2026". *Official Statistics News*, BPS, No. 52/06/Th. XXIX (June 2, 2026).
[52] Nur Rahmah, N., 2026. "Inflasi Mei Melonjak, Ekonom Peringatkan Daya Beli Masyarakat Tertekan", *Katadata* (June 4, 2026), citing Yusuf Rendy Manilet of CORE Indonesia.
[53] "Indonesia: economic growth rises in the first quarter of 2026," *Focus Economics* (May 5, 2026), on consumption and net trade; "Exports and Imports of Indonesia April 2026", *Official Statistics News*, BPS, No. 55/06/Th. XXIX (June 2, 2026), on April trade (exports +21.98% y/y; Jan–Apr surplus US$5.64 bn); Husna, F., 2026. "Indonesia Tourist Arrivals Expand 9.8% YoY", *Trading Economics* (January 5, 2026).
[54] "Indonesia Poverty Profile in September 2025", *Official Statistics News*, BPS, No. 19/02/Th. XXIX (February 5, 2026), on the "subsidised" poverty decline and the food share (74.67%) of the poverty line; on the ~40 percent volatile-food-and-administered weight in the CPI, see Bank Indonesia, *Inflation*. https://www.bi.go.id/en/fungsi-utama/moneter/inflasi/ (accessed on June 18, 2026).

Indicator (second wave)	Where It Stands Now (mid-2026)	Direction
Consumer prices / inflation	Headline 3.08% (May, within target); food 4.94% — highest since October — led by rice, fresh fish, cooking oil, chillies.	Rising, food-led.
Household welfare & demand	Q1 consumption still firm (+5.5%); economists flag purchasing-power pressure on low-income households; rupiah pass-through due Jun–Jul.	Resilient now, exposed.
Public health (haze)	Localised hotspots and haze in Sumatra–Kalimantan; no national haze crisis yet; risk rises with the Sept–Oct fire peak.	Latent.
Tourism	Strong — arrivals +9.8% y/y (Nov) to 1.2 m; accommodation & food the fastest-growing GDP sector in Q1 (+13.14%).	Healthy; haze risk ahead.
Trade & exports	April exports +21.98% y/y; Jan–Apr trade surplus US$5.64 bn; new palm-export levy (12.5%) and controls adding friction.	Solid, friction building.
Energy & water-intensive industry	Fertiliser costs up 30–50% (Middle East war); electricity & gas among the two sectors that contracted in Q1; generation mix to tilt fossil as hydro weakens.	Cost pressure building.
Public finances & external balance	Q1 deficit 0.93% of GDP (spending +31.4% vs revenue +10.5%); rupiah ~Rp17,200, –3.9% YTD; reserves –US$8.4 bn in Q1; BI rate hiked to 5.25% (June).	Expansionary, currency soft.

Table 3.2. The second wave at mid-2026: where the indirect, pecuniary channels stand.

The second wave, then, is in its opening phase. One channel, food prices, has clearly begun to move; the others remain near baseline but sit directly in the shock's path. The fiscal and external accounts deserve particular note: the budget is already running an expansionary, front-loaded stance, and the rupiah is already soft, which means the buffers that would normally absorb a climate shock are being drawn upon before that shock has fully landed.

3.1.3 The Macroeconomy: Still at Baseline, but Exposed

Seen from the top of the economy, mid-2026 looks deceptively strong. Growth ran at 5.61 percent year-on-year in the first quarter — the fastest since 2021 — carried by Eid-driven consumption and a surge in government spending, though forecasters expect the pace to ease toward 5.0–5.2 percent over the full year as those one-off drivers fade.[55] Unemployment is near a decadal low and poverty at a recorded low. Yet each of these headline strengths rests on a foundation the El Niño channels are built to erode. The poverty figure is, in the words of one analysis, a "subsidised" low — sustained heavily by social assistance, with a large share of households clustered just above a poverty line whose food component is close to three-quarters of the total — so that a food-price shock acts directly on the most exposed margin.[56] Employment's softness is one of quality rather than headcount, concentrated in the roughly one-third of the workforce still tied to agriculture. And the fiscal and currency buffers, as noted, are already partly committed. The macro ledger has not yet recorded the shock; it is simply standing where the shock will be felt.

[55] "Indonesia's Economic Growth Q1-2026", *Official Statistics News*, BPS, No. 48/05/Th. XXIX (May 5, 2026); on the full-year ~5.0–5.2% expectation, *Focus Economics*, (May 5, 2026) *op. cit.*, citing Nomura.
[56] "Indonesia Poverty Profile in September 2025", Official Statistics News, BPS, No. 19/02/Th. XXIX (February 5, 2026); "Indonesia's Economic Growth Q4-2025", Official Statistics News, BPS, No. 18/02/Th. XXIX (February 5, 2026); "Labour Situation in Indonesia November 2025", Official Statistics News, BPS, No. 21/02/Th. XXIX (February 5, 2026); "Labour Situation in Indonesia August 2025", Official Statistics News, BPS, No. 103/11/Th. XXVIII (November 5, 2025); "Indonesia Poverty Profile in March 2025", Official Statistics News, BPS, No. 63/07/Th. XXVII (July 25, 2025).

Indicator (macro)	Where It Stands Now (mid-2026)	Direction
Economic growth	Q1 2026 5.61% y/y (strongest since 2021), Eid- and spending-led; full-year seen ~5.0–5.2%, slowing in H2.	Strong baseline, softening ahead.
Inflation	3.08% (May), within target but up from April's 2.42%; food the driver; core 2.59%.	Rising within the band.
Government budget	Q1 deficit 0.93% of GDP on an expansionary stance; relief capacity (pumps, Bulog, reservoirs) being pre-positioned.	Widening, buffers readied.
Employment	Open unemployment 4.74% (Nov 2025), near a decadal low; agriculture ~41.6 m workers (~⅓ of jobs); informality the exposed soft spot.	Strong headline, exposed quality.
Poverty & welfare	8.25% / 23.36 m (Sept 2025), a record low — but "subsidised," food ≈75% of the poverty line, many households just above it.	Low but fragile.

Table 3.3. The macroeconomy at mid-2026: a strong baseline standing in the shock's path.

Taken together, the three snapshots describe a single economy caught at the front edge of a shock. The first wave is in the data; the second has begun to move through prices; the macro aggregates remain strong but rest on exactly the margins — the near-poor household, the informal farm job, the food-heavy basket, the already-stretched budget and currency — that the coming months are most likely to test. Where we are, in short, is the calm before the reckoning: close enough to the event to see it clearly, but not yet far enough in to have paid for it. What the model that follows seeks to do is trace how far that reckoning runs once the dry season reaches its peak.

3.2 The System Dynamics Simulation Modeling

Systems thinking is an approach to understanding complex phenomena that locates the source of a system's behavior in the structure of its interconnections — the web of feedback, accumulation, and delay that binds its parts — rather than in any single component or in a chain of isolated, linear causes.[57] System dynamics is the formal modeling discipline that operationalizes this view: developed by Jay Forrester and codified by John Sterman, it represents a system as a set of stocks (the quantities that accumulate), flows (the rates that change them), feedback loops (the circular causal paths that make a variable at once cause and effect), and time delays, and then simulates how that structure behaves over time.[58] We adopt it here because the propagation of an El Niño shock through the economy is precisely the kind of problem it was built to address. The shock does not travel down a single line from failed harvest to lost output; it cascades across interconnected sectors, doubles back through feedback loops — the reinforcing spiral by which lost income depresses demand and employment, the balancing pull of social protection against poverty — and unfolds with lags, from the months a palm tree takes to register water stress to the season over which relief and recovery play out.[59] A linear, sector-by-sector accounting captures the first, visible wave of losses but misses exactly what the simulation reveals to be roughly half the cost: the second-wave transmissions and the feedback that governs the recovery. System dynamics, by rendering those interconnections explicit, allows us to trace the full path of propagation, to distinguish reinforcing from stabilizing forces, and to locate the points at which policy can most effectively interrupt the chain.[60]

[57] Meadows, D.H., 2008, *Thinking in systems: a primer*. Chelsea Green Publishing, White River Junction.
[58] Forrester, J.W., 1961, *Industrial dynamics*, Cambridge, MA: MIT Press; and Sterman, J.D., 2000, *Business dynamics: systems thinking and modeling for a complex world*, Boston: Irwin/McGraw-Hill.
[59] Sterman, 2000, *op. cit.*, ch. 5, on feedback loops and time delays as the drivers of dynamic behavior.
[60] Meadows, 2008, *op. cit.*, on leverage points — the places within a system's structure where intervention yields the greatest effect.

The three waves traced so far describe propagation as a sequence: a shock strikes the rain-bound sectors, the loss travels outward through prices and public finances, and the macroeconomy records the cumulative toll. That sequence is real, but it is not the whole structure. An economy is not a one-way conveyor; the registers feed back on one another, so that the same variable can be both a consequence of the shock and a cause of its further spread. To make those return paths visible — and to fix the model's logic before it is given numbers — the system is represented in Figure 3.1 as a causal loop diagram (CLD), the standard device of system dynamics for showing how variables influence one another and where those influences close into loops.[61] The diagram inherits its variables from the three preceding sections and arranges them in the same four registers; what it adds is the wiring between them.[62]

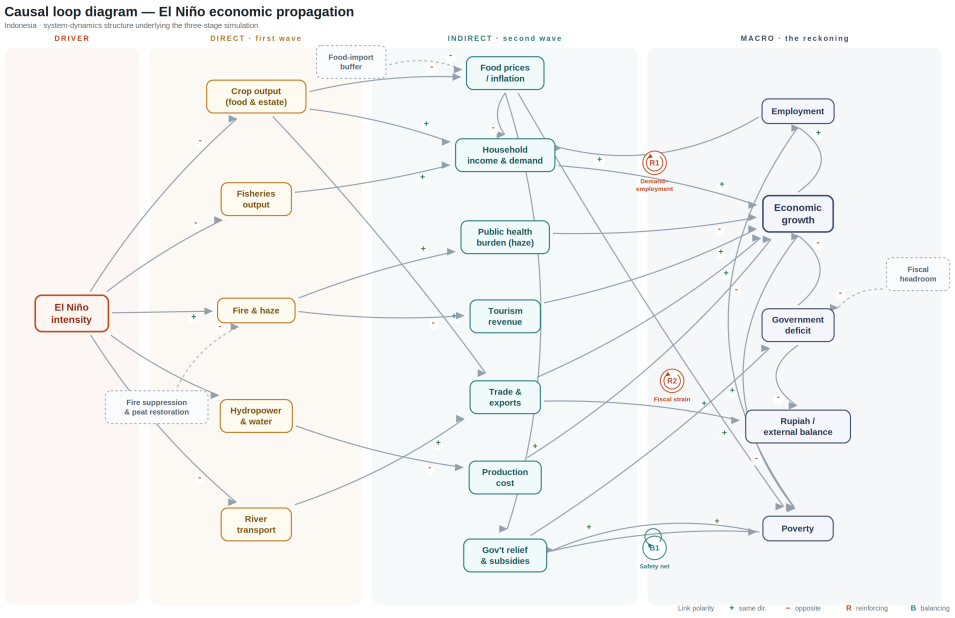

Figure 3.1 Causal loop diagram of El Niño economic propagation in Indonesia. Variables are grouped left to right into the driver (El Niño intensity), the direct first-wave sectors, the indirect second-wave channels, and the five macroeconomic indicators. Each arrow carries a polarity: "+" means the two variables move in the same direction, "–" that they move in opposite directions. Feedback loops are marked R (reinforcing) or B (balancing). Dashed nodes are exogenous policy levers, which enter negatively because they attenuate the shock.

Figure 3.1 above depicts the causal loop diagram (CLD) of the system dynamics model that propagates the effects of El Nino throughout the entire economy. The diagram is read first along its spine. El Niño intensity enters at the left and fans out to the six direct sectors — suppressing crop, fishery, hydropower, and river-transport output, and raising

[61] Sterman, 2000, *op. cit.*, ch. 5; and Meadows, 2008, *op. cit*.

[62] The variable set and the modelling framework build on the Low Carbon Development Initiative (LCDI) system-dynamics model and on Landscape Indonesia, ICEF (Indonesian Clean Energy Forum), and Landscape Advisory, 2021. *The Green Reset: Enhancing Ambition for Emission Reduction from the Energy Sector in Post-Pandemic Indonesia* (December 2021). Ministry of National Development Planning, Jakarta; Sari, A.P., P.A. Agustina, J. Low, D. Ramdani, 2024. *Growing Strong, Growing Green, Growing Renewables: Tripling Renewables and Doubling the Pace of Efficiency Improvement by 2030 in Indonesia*. Landscape Advisory, Jakarta; See also Ministry of National Development Planning (Bappenas), 2019, *Low carbon development: a paradigm shift towards a green economy in Indonesia*. Bappenas, Jakarta.

fire and haze — each link signed for the direction of the effect.[63] Those physical losses then drive the seven indirect channels: a fall in crop output raises food prices (a negative link, since output and prices move oppositely), fire and haze raise the public-health burden and depress tourism, and so on across the second wave. The channels in turn converge on the macro register, where economic growth sits as the central hub, drawing negative pressure from health costs, production costs, and the fiscal deficit, and positive support from demand, tourism, and exports. The polarity convention is what allows the chain to be traced unambiguously: multiplying the signs along any path gives the net direction of influence from one end to the other, which is how the reading is kept consistent even where a single variable is pushed in opposite directions by different channels.[64]

What turns this cascade into a system are the three feedback loops the diagram isolates. The first, labelled R1 (demand–employment), is reinforcing: household income lifts demand, demand lifts growth, growth lifts employment, and employment returns to lift income. Run forward, this is the ordinary multiplier; run in reverse — as an El Niño income shock sets it spinning the other way — it is the mechanism by which a contained agricultural loss becomes a broader demand contraction.[65] The second, R2 (fiscal strain), is also reinforcing, and is the loop that most concerns a government facing the shock with limited room: relief and subsidy spending widen the deficit, the wider deficit crowds out other growth-supporting outlays, slower growth deepens poverty, and deeper poverty calls forth still more relief. It is a vicious circle precisely when fiscal space is scarce — which, as the previous section showed, is close to the condition Indonesia carries into the 2026 dry season.[66]

Against that vicious loop the diagram sets a stabilising one. B1 (safety net) is balancing: rising poverty triggers relief spending, and relief, by supporting household incomes, pulls poverty back down. This is the counterweight that has held Indonesia's headline poverty rate at a record low — a low that analysts describe as "subsidised," sustained by social assistance rather than by structural gains, and therefore dependent on the safety net continuing to outrun the food-price shock that the first wave is feeding it.[67] The interplay between B1 and R2 is, in effect, the central policy question the model poses: whether the stabilising response can be delivered without the fiscal drag that turns the response itself into a source of harm.

The three policy levers enter the diagram as dashed, exogenous inputs, and each is signed negatively because its purpose is to weaken a link in the chain. The food-import and reserve buffer damps the pass-through from harvest shortfall to food prices; fire suppression and peatland restoration damp the conversion of drought into haze — the channel whose 2015 precedent cost the economy on the order of $16 billion, or roughly 1.9 percent of GDP, and whose health and tourism consequences the diagram routes

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[63] The sectoral first-wave links reflect the channels documented earlier in this paper; the rice channel in particular is already visible in the data, with rice-for-consumption output down 16.0 percent year-on-year in April 2026. *Official Statistics News*, BPS (June 2, 2026), *op. cit*.

[64] The price link rests on the food share of the consumer basket and the established commodity-price transmission of El Niño; on the latter, Cashin, *et al*., 2017, op. cit.

[65] The income–demand–growth–employment loop is the standard Keynesian multiplier rendered as feedback; see Sterman, 2000, *op. cit.*, ch. 5, on representing such multipliers as reinforcing loops.

[66] On the El Niño growth and fiscal channels through which the strain loop operates, Cashin, et al., 2017, *op. cit*.

[67] "CELIOS sends letter to UN over suspected irregularities in Indonesia's economic growth data," *CELIOS (Center of Economic and Law Studies)*, (August 2025). https://celios.co.id/celios-sends-letter-to-un-over-suspected-irregularities-in-indonesias-economic-growth-data/ (accessed on June 18, 2026); "Celios spotlighted the anomaly of the source of economic growth in 2025," *Voice of Indonesia*, (February 8, 2026); World Bank, 2023, *Looking beyond aggregate poverty and vulnerability rates in Indonesia: aligning social protection with sources of vulnerability to poverty*, Policy Note, Report No. 178952, World Bank, Jakarta; Isaac, J., 2026. "Economist questions logic behind Indonesia's 2025 economic growth data," *Indonesia Business Post*, (February 11, 2026); *Focus Economics*, (May 5, 2026), *op. cit*.

accordingly; and fiscal headroom damps the deficit, easing the crowding-out that powers R2.[68] Their placement makes explicit where intervention acts: not on the El Niño itself, which is exogenous, but on the strength of the transmissions that carry its effects into the economy.

Two qualifications govern how the figure should be read. First, a CLD is structural rather than quantitative: it fixes the architecture of influence and the sign of each link, but not the magnitudes — those are supplied by the simulation that follows, which translates this wiring into stocks, flows, and calibrated coefficients.[69] Second, the loops do not all matter equally at every moment. Early in the event, while the shock is still loading, the feed-forward spine dominates and the feedback loops are quiet; it is in the months after the peak, as relief is disbursed and incomes adjust, that R2 and B1 come to govern the path — which is why the question of recovery is, in this model, a question about which of those two loops prevails.

3.3 The Results of the Simulations Across the Three Registers

The model was run for the 2026 event across the four ENSO intensities — weak, moderate, strong, and super — with the policy levers (the food-import buffer, fire suppression, and fiscal headroom) held at a moderate setting.[70] The figures below report the *contemporaneous* change in each indicator: the shift relative to a counterfactual year with no El Niño, in which growth holds at its roughly 5.0 percent baseline.[71] Because the present event's eventual magnitude is still uncertain — with forecasters placing the central risk in the strong-to-super range — the strong (ONI ≈ 1.7) and super (ONI ≈ 2.0) columns carry the headline interpretation, while the weak and moderate columns show how the damage scales down if the event stays mild.[72] The numbers are scenario outputs of a reduced-form model, not forecasts, and should be read as the order of magnitude and the *shape* of the propagation rather than as point predictions.

3.3.1 The First Wave

The direct sectors lose output in proportion to how tightly their production is bound to rainfall, but their weight in the national accounts is what converts those physical losses into GDP. The two registers diverge sharply. Forestry and peatland suffer the largest proportional loss — output down 12 to 16 percent under a strong-to-super event, as drought primes the fire season — yet because the sector is small, its contribution to GDP loss is modest. Estate and food crops show smaller percentage losses but, carrying far more economic weight, account for the largest share of the direct hit. Summed across all six sectors, the first wave subtracts on the order of 0.7 to 0.9 percent of GDP under a strong-to-super event.[73]

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[68] On the cost of the haze channel, World Bank, 2016, *op. cit*.
[69] On the progression from a qualitative causal loop diagram to a quantified stock-and-flow simulation, Sterman, 2000, *op. cit*., chs. 5–6.
[70] The model is the calibrated system-dynamics specification described above, built on the LCDI framework; the policy levers are held at a moderate (mid-range) setting for the central run, with sensitivity to that setting discussed below. On the method, Sterman, 2000, *op. cit*.
[71] The counterfactual baseline of ~5.0 percent growth follows the full-year 2026 consensus; BPS recorded 5.61 percent year-on-year in the first quarter, with forecasters expecting ~5.0–5.2 percent for the year. See *Official Statistics News*, BPS (May 5, 2026), *op. cit*.
[72] On the intensity odds underlying the strong-to-super central case, NOAA's projection leaves a roughly 50 percent chance of a strong and 25 percent chance of a very strong event. Jong, 2026, *op. cit*.
[73] Sector GDP weights and loss ceilings are calibrated to the documented record, including the ~16 percent year-on-year fall in rice-for-consumption output already observed in April 2026. *Official Statistics News*, BPS (May 5, 2026), *op. cit*.

First-wave sector	Output loss (Strong → Super)	Δ GDP contribution, pp (Strong → Super)
Food crops (rice et al.)	8.0% → 10.0%	0.24 → 0.30
Estate crops (palm, coffee, cocoa)	4.0% → 5.0%	0.14 → 0.18
Fisheries	4.9% → 6.0%	0.13 → 0.16
Forestry & peatland (fire)	12.1% → 16.0%	0.10 → 0.13
Water & hydropower	9.7% → 12.0%	0.07 → 0.09
River transport	6.5% → 8.0%	0.03 → 0.04
Direct total	—	0.71 → 0.90 % of GDP

Table 3.4. First-wave results: modeled output losses and their contribution to GDP loss.

The estate-crop figure deserves a note: the model registers the loss within the event year, but the empirical record — and the 2026 industry warnings — point to the deeper palm-yield damage arriving with a six-to-twelve-month lag, so the contribution shown here is best read as the leading portion of a loss that extends into the following year.[74]

3.3.2 The Second Wave

The indirect channels carry the first wave's losses outward, and in aggregate they now surpass it: the second wave subtracts a further 1.0 to 1.4 percent of GDP under a strong-to-super event, so that the indirect toll exceeds the direct one.[75] Within the second wave, the largest drag is the public-health burden carried by haze — close to 0.40 percent of GDP at the super intensity — followed by the demand and trade channels as food-led inflation erodes real purchasing power. The price channel itself, shown here as a GDP drag, also surfaces as the headline inflation transmission: the model lifts headline inflation by roughly 3.5 to 4.4 percentage points under a strong-to-super event, consistent with the commodity-price response documented for El Niño in commodity-sensitive economies.[76]

Second-Wave Channel	GDP Drag, Strong (1.7)	GDP Drag, Super (2.0)
Consumer prices / inflation	0.08	0.11
Household welfare & demand	0.14	0.20
Public health (haze)	0.29	0.40
Tourism	0.18	0.26
Trade & logistics	0.27	0.37
Energy & water-intensive industry	0.03	0.05
Public finances	0.02	0.02
Indirect total	1.01	1.41 % of GDP

Table 3.5. Second-wave results: each channel's modeled drag on GDP (percentage points).

The structure here matters as much as the totals. That the second wave now exceeds the first is the model's central qualitative finding: the bulk of an El Niño's economic cost is not the crops and forests it destroys directly, but the price, demand, health, and fiscal

[74] On the lagged palm-oil response and the 2026 loss warning, "Indonesia warns that palm oil production could fall by up to 2 million tons in 2026," *Click Oil & Gas*, (April 29, 2026); and "Investment banks forecast elevated CPO prices through 2026, strong El Niño seen as key driver," *Palm Oil Magazine*, (May 18, 2026).
[75] The forestry, health, and tourism channels are anchored to the cost of the 2015 fire-and-haze crisis. World Bank, 2016, *op. cit*.
[76] Cashin, *et al*., 2017, *op. cit*.

consequences that follow — which is precisely why the policy levers act on these channels rather than on the weather.

3.3.3 The Macroeconomy

Carried into the macro register, the two waves combine into a total output loss of roughly 1.7 to 2.3 percent of GDP under a strong-to-super event — an order of magnitude comparable to — and at the super intensity somewhat above — the World Bank's estimate for the 2015 fire crisis alone.[77] The five headline indicators move accordingly, and Table 3.6 shows the full gradient.

Macro indicator	Weak (0.7)	Moderate (1.2)	Strong (1.7)	Super (2.0)
Total output loss (% of GDP)	0.30	0.91	1.72	2.31
Economic growth (from 5.0%)	4.96 (–0.04)	4.74 (–0.26)	4.47 (–0.53)	4.32 (–0.68)
Inflation (+pp, headline)	+1.05	+2.17	+3.49	+4.36
Government budget (deficit, +pp of GDP)	+0.40	+0.47	+0.55	+0.60
Employment (agricultural jobs stressed, m)	0.8	1.7	2.8	3.5
Poverty (+pp / million people)	+0.07 / 0.2	+0.22 / 0.6	+0.40 / 1.1	+0.52 / 1.5

Table 3.6. Macroeconomic results across the ENSO intensity range.

Read against the baseline of the previous section, these are meaningful but not catastrophic figures for an isolated climate shock — which is what the empirical literature would lead one to expect.[78] Growth is shaved by 0.5 to 0.7 percentage points under a strong-to-super event, pulling the rate from roughly 5.0 percent toward 4.3–4.5 percent. Inflation rises by 3.5 to 4.4 points, enough to push a food-led headline rate from the middle of Bank Indonesia's target band toward or through its upper edge. The deficit widens modestly — by roughly half a point, 0.55 to 0.6 points of GDP — as relief, food imports, and subsidies are deployed against softer rural revenue. The sharpest edge, however, is distributional. Between 2.8 and 3.5 million agricultural livelihoods are stressed into underemployment, and poverty rises by 0.40 to 0.52 percentage points — between 1.1 million and 1.5 million people pushed below the line — enough to reverse a meaningful share of the hard-won decline that left the rate at a record 8.25 percent.[79]

Three findings stand out from the run as a whole. First, the second wave is not a minor sequel to the first but its larger partner, so that any accounting confined to crop and forest losses understates the true cost by more than half. Second, the aggregate macro hit is real but absorbable — a growth and inflation disturbance of a percentage point or so — which means the event's danger lies less in the headline numbers than in where it lands. Third, that landing is concentrated on exactly the margins the baseline left exposed: the food-heavy household budget, the informal farm job, and a fiscal position already running expansionary. The model thus locates the policy problem not in preventing a national contraction, which is unlikely, but in protecting the specific households and workers on whom the distributional weight of the shock falls — the task to which the policy levers, and the balancing loop they feed, are addressed.[80]

[77] World Bank, 2016, *op. cit.*, estimating losses on the order of 1.9 percent of GDP for the 2015 fire crisis.
[78] Cashin, *et al.*, 2017, *op. cit*.
[79] The inflation and welfare channels are calibrated to the food weight of the consumer basket; volatile-food and administered prices account for roughly 40 percent of the CPI. Bank Indonesia, *Inflation*, *op. cit*.
[80] On reading the post-peak trajectory as a contest between the reinforcing fiscal-strain loop and the balancing safety-net loop, see the causal loop diagram and discussion above; and Sterman, 2000, *op. cit.*, chs. 5–6.

4 The Policy Implications

The simulation's value for policy lies less in the magnitudes it produces than in the structure it exposes — where, along the chain from weather to welfare, intervention actually has leverage. Three results carry most of the weight. The second wave exceeds the first, so the larger share of the cost is pecuniary rather than physical. The aggregate macro hit is real but absorbable, but the distributional hit is sharp. And, most telling for policy, the buffers the model can vary move the growth number only modestly but bend inflation and poverty substantially. Running the super event from weak to strong buffering changes growth by roughly half a percentage point — from 4.18 to 4.64 percent — yet more than halves the inflation uplift, from +5.8 to +2.6 percentage points; trims the second wave by nearly two-thirds; and keeps roughly 1.9 million people out of poverty, with the headcount increase falling from about 2.3 million to 0.4 million.[81] The implications that follow all turn on this asymmetry: policy cannot do much about the size of the shock, but it can do a great deal about who bears it and how far it travels.

The first implication is therefore a reframing. Because the direct losses are weather-determined and largely fixed, the object of policy is not to prevent a national contraction — which the model suggests is unlikely in any case — but to interrupt the transmissions that decide the shock's incidence.[82] An accounting confined to crop and forest damage, and a response confined to compensating it, addresses barely half the cost and the least tractable half at that. The leverage is downstream, in the price, demand, health, and fiscal channels that the second wave runs through, and it is there that intervention earns its highest return.

That leverage is greatest, and most urgent, in the food-price channel, which is why food-price stabilisation tied to adaptive social protection should be the centrepiece of the response. The sharpest result in the entire run is distributional, and it propagates through a single mechanism: with food comprising roughly three-quarters of the basket that defines the poverty line, a harvest shortfall translates almost directly into poverty. Two instruments answer it. The first is supply-side stabilisation — drawing on Bulog's reserves and timing strategic imports to land ahead of the September–October peak, when the rice-deficit window is widest — which the model represents as the food-import buffer and which bends both inflation and the poverty headcount. The second is shock-responsive cash transfer, scaled to the near-poor and delivered through the social-registry rails that already exist, so that the safety net moves with the price shock rather than lagging it. The model's balancing loop is precisely this safety net; the policy task is to ensure it outruns the food-price wave it is meant to absorb.

Fire prevention deserves to be treated as macroeconomic policy rather than as environmental housekeeping. Forestry and peatland register the largest proportional loss in the first wave, and they are the source of the haze externality that drives the health and tourism drags in the second; the 2015 precedent put the cost of an uncontrolled fire season on the order of 1.9 percent of GDP.[83] Against that, the marginal cost of prevention — peatland rewetting, early suppression, and enforcement on the concessions where the model and the monitoring data locate most hotspots — is small,

[81] Lever-sensitivity run of the model at the super intensity (ONI ≈ 2.0): strong versus weak buffering yields inflation of +2.6 vs +5.8 pp, a deficit of +1.17 vs +0.28 percentage points (pp) of GDP — buffering widens rather than narrows the deficit, because the stronger relief is itself deficit-financed — a second-wave drag of 0.69 vs 1.70 percent of GDP, and a poverty increase of +0.14 pp (≈0.4 m) vs +0.81 pp (≈2.3 m), against a growth change of about 0.5 pp.
[82] On the bounded character of El Niño's aggregate macro effects, Cashin, et al., 2017, *op. cit*.
[83] World Bank, 2016, *op. cit*.

and its return is high. Like the other levers, it is pre-emptive: rewetting and suppression capacity must be in place before the dry season peaks to matter at all.[84]

The fiscal channel, however, is where the response is most likely to defeat itself, and it warrants the most caution. The deficit widens by roughly half a point of GDP (0.55 to 0.6) under a strong-to-super event, and it does so on top of a baseline that is already expansionary — a first-quarter deficit near 1 percent of GDP, spending growing far faster than revenue, a currency down nearly 4 percent on the year, and reserves falling.[85] The model's reinforcing fiscal-strain loop captures the danger directly: relief financed without genuine space widens the deficit, the wider deficit crowds out other growth-supporting outlays, slower growth deepens poverty, and deeper poverty calls forth still more relief. The implication is not to withhold relief but to fund it in a way that does not spring this loop — pre-positioning contingency space now rather than improvising later, financing through reallocation and tight targeting rather than blanket subsidy, and guarding external and monetary stability so that a weakening rupiah does not add a layer of imported inflation to the food shock.[86] The balancing safety net and the reinforcing fiscal strain are fed by the same spending; the design of its financing decides which loop dominates.

A monetary corollary follows. The inflation the model produces is supply-driven — food and haze, not demand — and the country's core rate remains moderate even as the headline rises.[87] Tightening policy against a supply shock would compound the growth drag without touching its cause. The appropriate response runs through the supply side and the existing inflation-control coordination between the central bank and government, leaning on food logistics and administered-price management, and reserving monetary tightening for genuine second-round effects or for pass-through from the currency rather than for the first-round food spike itself.[88]

Cutting across all of these is the question of timing. The preceding section placed the event still in its loading phase, with the peak expected between September and October; every lever the model contains is pre-emptive, effective only if in place before the shock lands.[89] Reserves must be stocked, peat rewetted, transfer registries readied, and fiscal contingency set aside while the dry season is still building. The policy window, in other words, is not some future moment of crisis but the present one, and its value decays as the peak approaches.

Finally, beyond the management of this event lies the longer task of lowering the loss ceilings themselves. The levers attenuate a given shock; resilience investment shrinks the shock. Irrigation and water storage reduce the rice and hydropower losses that anchor the first wave; drought-tolerant varieties and peatland restoration reduce the crop and fire losses; and a diversified, less hydro-dependent generation mix keeps a drought from tilting the power system back toward diesel and coal precisely when emissions and costs are already under strain.[90] Each of these shifts the model's entire response curve downward for future events, and each ties the El Niño response to Indonesia's broader low-carbon and energy-transition agenda rather than treating climate adaptation and mitigation as separate ledgers. The same logic explains why the response cannot be run from any single ministry: because the cost lives in transmissions that cross sectors — agriculture into prices into poverty, fire into health into tourism into trade, relief into the

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[84] Jong, 2026, *op. cit*.
[85] *Focus Economics*, (May 5, 2026), *op. cit*., on the ~0.93-percent-of-GDP first-quarter deficit and the spending–revenue gap; "Indonesia economy grows 5.61% in early 2026, beating expectations," *IDN Financials*, (May 5, 2026), on the rupiah (–3.88% YTD) and falling reserves.
[86] Sterman, 2000, *op. cit*.
[87] Bank Indonesia, *Inflation*, *op. cit*.
[88] "May inflation surges, economists warn public purchasing power is under pressure," *Business Indonesia*, (June 2026), citing CORE Indonesia.
[89] Situmorang, 2026, *op. cit*.; Jong, 2026, *op. cit*.
[90] Bappenas, 2019, *op. cit*.

deficit into growth — a siloed reaction necessarily misses the loops, and the coordination the diagram implies is institutional as much as analytical.[91]

Lever / Instrument	Channel It Acts On	Model Result it Bends (Super Event)	Timing Window
Food-price stabilisation + adaptive social protection — Bulog reserve release, strategically timed imports, shock-responsive cash transfers to the near-poor	Consumer prices → household welfare → poverty	Headline inflation +4.4 → +2.6 pp; poverty headcount 1.5 m → 0.7 m (≈800,000 fewer); second wave 0.76 → 0.67% of GDP	Pre-peak — stock and pre-position now; release ahead of the Sept–Oct rice-deficit window
Fire prevention — peatland rewetting, early suppression, concession enforcement	Fire & haze → public health + tourism (and forestry output)	Health + tourism drag 0.66 → 0.40% of GDP (≈ –39%); contains the largest single first-wave proportional loss	Pre-peak — suppression and rewetting capacity in place before the dry-season peak (Jul–Aug)
Fiscal headroom & relief-financing design — contingency space, reallocation over blanket subsidy, tight targeting	Public finances → crowding-out → growth & poverty (loop R2 vs B1)	Deficit widening +1.1 → +0.9 pp of GDP; defuses the reinforcing fiscal-strain loop	Now — reserve space before disbursement begins; maintain throughout the event
Monetary stance (supply-focused) — lean on TPIP/TPID food-logistics coordination, not rate hikes	Inflation pass-through & external balance	Avoids compounding the –0.9 pp growth drag; matches the supply-led (not demand-led) source of the inflation	Through event — tighten only for rupiah pass-through or genuine second-round effects
Structural resilience — irrigation and water storage, drought-tolerant varieties, peatland restoration, diversified/less hydro-dependent generation	Lowers the first-wave loss ceilings (sectoral output sensitivity)	Shifts the whole response curve downward for future events; reduces each sector's loss ceiling rather than the current shock	Medium run — built between events, not during
Cross-ministry coordination — Bapanas/Bulog, BMKG/BNPB/Forestry, Finance Ministry, Bank Indonesia, social-protection agencies	All loops — the transmissions cross sectors	Ensures the buffers act jointly rather than in silos; the precondition that makes every row above effective	Standing — established before, exercised during

Table 4.1. Policy-priority synthesis: each lever, the transmission it acts on, the modeled result it bends, and its timing window. Figures are the marginal effect of moving one lever from moderate to strong buffering at the super intensity (ONI ≈ 2.0), holding the others moderate. Per-lever isolation run of the model at the super intensity (ONI ≈ 2.0): with the other levers held at a moderate setting, strengthening the food-import buffer alone moves headline inflation from +4.4 to +2.6 pp and the poverty headcount from ≈1.5 m to ≈0.7 m; strengthening fire management alone reduces the combined public-health-and-tourism drag from 0.66 to 0.40 percent of GDP; and strengthening fiscal headroom alone narrows the deficit widening from +1.1 to +0.9 pp of GDP.

Taken together, the simulation recasts El Niño from a disaster to be weathered into a propagation to be managed. Its size is largely beyond policy's reach, but its incidence and its reach are not — provided the buffers are funded, targeted, coordinated across the agencies whose channels the shock crosses, and, above all, put in place before the peak.

[91] Sterman, 2000, *op. cit*.

5 Concluding Note

This paper set out to trace how a super El Niño moves through the Indonesian economy — not as a single blow to agriculture, but as a shock that propagates, in three successive waves, from the rain-bound sectors it strikes first, outward through the channels of price, health, demand, and public finance, and finally into the headline indicators by which a nation measures its condition. Writing in the middle of 2026, with the event still gathering and its peak expected only in the dry season's depth between September and October, this is necessarily an account composed from inside the event rather than after it.[92] What the analysis offers, therefore, is less a tally of damage already done than a map of how the damage will travel if the event matures as feared.

The central finding is that the indirect, second wave is not a minor sequel to the first but its larger partner. Under a strong-to-super event, the direct losses in crops, fisheries, forests, water, and river transport subtract on the order of 0.7 to 0.9 percent of GDP, while the pecuniary channels that carry those losses outward subtract a further 1.0 to 1.4 percent — so that an accounting confined to scorched fields and failed harvests captures less than half of the true cost.[93] This is the proposition the system-dynamics lens was chosen to reveal: that an El Niño's economic weight lies in transmission rather than in destruction, and that the feedback loops binding the registers together — the reinforcing spiral by which fiscal strain can deepen the very poverty relief is meant to ease, and the balancing pull of the safety net against it — are what govern the recovery once the rains return.

Read in aggregate, the macroeconomic results are real but absorbable: growth shaved by roughly 0.5 to 0.7 percentage points, from about 5.0 toward 4.3–4.5 percent; inflation lifted by some 3.5 to 4.4 points; the deficit widened by about half a percentage point of GDP.[94] The danger the model locates is not national contraction, which it suggests is unlikely, but distribution. The shock falls hardest precisely where the economy is thinnest — on the food-heavy budget of the near-poor household, on the informal agricultural job, on a fiscal position already running expansionary and a currency already soft — pressing between 2.8 and 3.5 million livelihoods into underemployment and tipping 1.1 to 1.5 million people back below the poverty line.[95] The headline ledger registers the average; it does not register the incidence, and it is in the incidence that the human cost of this event will be found.

From this follows the paper's policy argument, which is at bottom a single claim: that the size of the shock is largely beyond policy's reach, but its incidence and its reach are not. The lever analysis bears this out — buffering scarcely moves the growth number, yet it nearly halves the inflation uplift, the deficit widening, and a meaningful share of the poverty increase. The returns to policy thus lie not in the weather or even the harvest but in the transmissions: in food-price stabilisation tied to adaptive social protection, in fire prevention treated as macroeconomic rather than merely environmental policy, in relief financed so as not to spring the fiscal trap, in a monetary stance aimed at a supply shock rather than a demand one, and, over the longer run, in the resilience investments that lower the loss ceilings themselves. Binding all of these is the matter of timing. Every instrument the model contains is pre-emptive, and its value decays as the dry season

[92] Situmorang, 2026, *op. cit.*; Jong, 2026, op. cit.
[93] Model results, this paper; calibration anchored to the documented record, including the World Bank's estimate of ~1.9 percent of GDP for the 2015 fire crisis. World Bank, 2016, *op. cit*.
[94] The counterfactual baseline of ~5.0 percent follows the full-year 2026 consensus. See *Official Statistics News*, BPS (May 5, 2026), *op. cit*.
[95] On the food share of the poverty line and the large near-poor population on which the distributional weight falls, *Official Statistics News*, BPS, (February 5, 2026), *op. cit*.

deepens — which means the decisive choices must be made now, while the shock is still loading, not later, when it has already landed.

These conclusions should be read with their limits in plain view. The figures are scenario outputs of a reduced-form, deliberately conservative model, not forecasts; the event's eventual magnitude remains genuinely uncertain, spanning the range from a mild disturbance to the super event around which the central case is drawn; and even the baseline against which the shock is measured rests on national accounts whose strength some independent analysts have questioned.[96] The model's contribution is not precision but structure — the shape of the propagation, the order of its magnitudes, and the location of the points at which it can be interrupted. Within those bounds, it does what a model of a system should: it makes the invisible architecture of a shock visible, and in doing so converts a hazard that can only be endured into a propagation that can, in part, be governed.

The fire named in this paper's title is still on the horizon. The smoke, for now, remains a forecast. But the propagation it would set in motion is already legible in the structure of the economy it would strike, and the window in which that propagation can be blunted is open now and narrowing. Whether the months ahead are remembered as a managed disturbance or as another entry in the long ledger of El Niño's costs to Indonesia will depend less on the strength of the event than on the speed and the aim of the response that meets it.

[96] On reservations regarding the official growth data, see the analyses of CELIOS discussed above; on the bounded but significant macro effects of El Niño generally, Cashin, et al., 2017, *op. cit*.

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