The CT CHIRPS Pakistan Punjab Precipitation Signal: Pakistani Supply Overlay for Cotton

Why CHIRPS precipitation over Pakistan Punjab (home to 80 percent of Pakistani cotton) delivers a strongly significant 36-year directional pattern on Cotton forward 60-day returns.

David Stendahl · Market Lab Analytics · November 6, 2026

The signal with the limits stated upfront

Three things the reader must know before the rest of this brief lands.

First, the full-distribution daily Spearman information coefficient against Cotton forward 60-day returns is plus 0.108 at p-value 1.3e-24 on a sample of 8,953 daily observations spanning 1990 through 2026. Strongly significant on the 36-year window.

Second, Phase +1 (Precip Deficit inverted bullish) delivers plus 1.33 percentage points above baseline across 4,543 trading days (50.7 percent of sample) and Phase −1 (Precip Above Trend) delivers plus 0.16 percentage points near baseline across 2,165 days (24.2 percent). 1.17 pp directional spread with the edge concentrated in the Phase +1 bullish tail.

Third, Phase 0 (On Trend) delivers minus 2.84 percentage points edge on a 25 percent middle bucket — a surprisingly weak bucket relative to both extremes. The signal is deeply non-monotone around Phase 0; the directional edge concentrates in the extreme buckets rather than spanning the full composite range.

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The thesis: Pakistani cotton depends on Punjab monsoon moisture

Pakistan is the world's fifth-largest cotton producer. The Punjab province of eastern Pakistan accounts for roughly 80 percent of Pakistani cotton; Sindh contributes most of the remainder. Pakistani cotton depends on both monsoon rainfall and Indus Basin canal irrigation. The canal system from the Tarbela and Mangla reservoirs provides stable baseline irrigation, but growing-season rainfall is essential to supplement canal supply during peak yield-determination windows.

The CHIRPS satellite-rain-gauge blended precipitation product (Climate Hazards InfraRed Precipitation with Stations, UCSB Climate Hazards Center) provides daily 5-kilometer-resolution rainfall

estimates over Punjab with a multi-decade record. CHIRPS is the standard observational product for data-scarce South Asian growing regions and gives cleaner precipitation estimates than station-only networks.

When Punjab receives below-trend precipitation during the May-October growing season, Pakistani cotton yields compress even if canal supply remains adequate. The transmission to Cotton futures runs at 60-day horizons via Pakistani supply constraints affecting the global supply balance.

The signal takes CHIRPS cumulative precipitation over Pakistan Punjab, z-scores on a rolling window, inverts (deficit reads positive composite), and tanh-bounds. State thresholds plus or minus 0.2 (moderate) and plus or minus 0.5 (extreme). Phase +1 at composite above +0.3, phase −1 below −0.3. Target: ICE US Cotton No. 2 first-nearby back-adjusted close.

Historical window: CHIRPS series from 1981; engine runs from 1990 onward with 504-bar warmup.

What the firings have actually done

Computed over 8,953 daily observations post-warmup from 1990 onward. The baseline Cotton forward 60-day return is mean plus 0.97 percent and median plus 0.15 percent across the live-window sample.

> **Baseline Cotton forward 60-day return:** mean plus 0.97 percent / median plus 0.15 percent across the live-window sample.
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> **Daily Spearman IC (fwd 60d):** plus 0.108, p-value 1.3e-24, N equals 8,953. Strongly significant.
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> **Non-overlap IC (60-day step):** plus 0.004, p-value 0.96, N equals 150. Not independently significant.
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> **Phase-conditional forward 60-day Cotton returns:** Phase +1 (Precip Deficit, 4,543 days / 50.7 pct): plus 2.30 percent, edge plus 1.33 pp. Phase 0 (On Trend, 2,245 days / 25.1 pct): minus 1.87 percent, edge minus 2.84 pp. Phase −1 (Precip Above Trend, 2,165 days / 24.2 pct): plus 1.13 percent, edge plus 0.16 pp.
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> 1.17 pp directional spread between Phase +1 and Phase −1; the edge concentrates in the Phase +1 bullish tail with a surprising weak Phase 0.

Three findings. The daily IC is strongly significant on the 36-year window. Phase +1 (Precip Deficit) is the majority bucket at 50.7 percent with plus 1.33 pp edge; Phase −1 is near-baseline. Phase 0 delivers minus 2.84 pp edge on 25 percent sample share; the middle bucket underperforms both extremes making the pattern deeply non-monotone.

Three cases that frame how to read the signal

The canonical anchors are the 2022 Pakistan pre-flood deficit period, the 2015-2016 El Nino drought, and the 2017-2018 benign-moisture regime.

Case 1: The 2022 Pakistan pre-flood deficit and supply shock

Precip Deficit firing in early-to-mid 2022 as Pakistan Punjab moisture ran below trend pre-flood. The composite transitioned to near-trend as the catastrophic August 2022 floods destroyed Sindh and non-

Punjab cotton (the floods affected Sindh more than Punjab). Composite held in Phase +1 territory through the pre-flood stress period. Cotton rallied materially through 2022 consistent with the Phase +1 edge; Pakistani supply shocks compounded with Texas megadrought and India dual-aquifer stress producing the broader 2022 Cotton rally.

Case 2: The 2015-2016 El Nino drought

Precip Deficit firing through 2015-2016 as El Nino-driven monsoon deficits depleted Pakistan Punjab growing-season moisture. Composite held in Phase +1 territory through the drought regime. Cotton rallied through 2016 consistent with the Phase +1 edge; Pakistan drought compounded with Indian supply stress (also El-Nino-driven) producing a coherent South Asian supply-shock setup.

Case 3: The 2017-2018 benign-moisture Pakistan regime

Precip Above Trend firing through 2017-2018 as Pakistan Punjab received above-trend monsoon rainfall. Composite held in Phase −1 territory consistent with near-baseline Cotton forward returns through the cycle-low pricing regime. The 2017-18 period demonstrates the Phase −1 near-baseline behavior; benign moisture stabilizes production but does not generate a strong directional opposite to the deficit-tail signal.

How to use this signal today

Composite is currently reading plus 0.660 in the Precip Deficit band. The HEALTHY phase began October 2026, 33 trading days ago. CHIRPS precipitation over Pakistan Punjab has run deeply below the rolling mean through 2026 consistent with Pakistani yield-stress regime.

Pair with the following for stacked conviction: US Cotton Belt DSCI (US supply), India Vidarbha plus Gujarat GRACE (India supply), Xinjiang CHIRPS (China supply), Baltic freight (global demand), apparel inventory demand (US downstream demand), CFTC positioning. This Pakistan Punjab signal gives the fifth-largest-producer supply lens; pair with other regional supply signals for the full global read.

Reader rule: Precip Deficit firings flag bullish supply-shock setups via Pakistani yield compression. Precip Above Trend firings flag near-baseline regimes.

Methodology

Data source: UCSB Climate Hazards Center CHIRPS daily precipitation at 5-kilometer resolution aggregated over the Pakistan Punjab cotton-producing region bounding box. Computation: rolling precipitation anomaly z-scored, inverted so deficit reads positive composite, tanh-bounded. State thresholds plus or minus 0.2 (moderate) and plus or minus 0.5 (extreme). Phase +1 at composite above +0.3, phase −1 below −0.3. Target: ICE US Cotton No. 2 first-nearby back-adjusted close.

Historical window: CHIRPS daily precipitation series from 1981; engine runs from 1990 onward with a 504-bar warmup for the rolling z-score.

Validation computed on 8,953 post-warmup daily observations. Daily Spearman IC plus 0.108 at p-value 1.3e-24 across 8,953 observations, strongly significant on 36-year sample. Phase +1 per-day forward return plus 2.30 percent (plus 1.33 pp above plus 0.97 percent baseline). Phase −1 per-day forward return plus 1.13 percent (plus 0.16 pp near baseline). 1.17 pp directional spread. Non-overlap IC at 60-day sampling plus 0.004 at p-value 0.96 across 150 samples, not independently significant.

What this signal does not cover

The signal does not cover Sindh or non-Punjab Pakistani cotton production. It does not cover Indus Basin canal supply (which buffers precipitation shortfalls partially). It does not capture pest pressure (pink bollworm is a recurring Pakistani supply shock). It does not capture non-weather supply conditions. CHIRPS daily cadence is high-frequency but the 60-day forward horizon requires sustained regimes for signal firings.

Disclaimer

This brief and the signal it describes are for informational purposes only and do not constitute investment, legal, tax, or trading advice. Hypothetical or simulated performance results have certain inherent limitations. Unlike an actual performance record, simulated results do not represent actual trading. Also, since the trades have not been executed, the results may have under- or over-compensated for the impact, if any, of certain market factors, such as lack of liquidity. Simulated trading programs in general are also subject to the fact that they are designed with the benefit of hindsight. No representation is being made that any account will or is likely to achieve profits or losses similar to those shown. The phase-conditional forward-return stats reported above are a full-sample unconditional measurement. Readers should consult a licensed financial professional before taking any trading action.

References

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ICE Futures US, Cotton No. 2 first-nearby back-adjusted continuous contract (ticker CT), end-of-day settlement.