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A global coffee drought index monitor

CHRISTIAN BUNN, FABIO CASTRO

The Alliance of Bioversity International & CIAT, Climate Action, Colombia

Abstract

Global coffee production is increasingly threatened by climate change, with drought emerging as one of the most critical hazards affecting yield stability and supply reliability. Drought impacts are often telecoupled, with climate anomalies in key producing regions affecting prices and thereby distant livelihoods and food security. Improved insights into the spatial and temporal prevalence of drought in coffee-growing regions are therefore essential for both agronomic management and financial risk mitigation.

We developed a globally consistent, near-real-time monitoring framework to quantify drought characteristics across major coffee-producing areas using the Standardized Precipitation-Evapotranspiration Index (SPEI). SPEI has been identified to be more appropriate for climate impact research because it captures both precipitation and temperature variability, and decreased cloud cover.

First, we spatially disaggregated FAOstat national production statistics by combining subnational harvested area statistics with probabilistic agroecological suitability masks and land cover constraints to approximate the global distribution of coffee cultivation. Second, we computed SPEI at 3-, 6-, and 12-month timescales for the baseline (1981–2020), aligned with region-specific phenological calendars based on the timing of the rainy season. Climate inputs were derived from near-real-time reanalysis data provided by Copernicus Climate Data Store (ERA5), enabling continuous updates of drought conditions.

Third, we defined a Global Coffee Drought Index (GCDI) as the area-weighted sum of drought intensity ($\text{SPEI} < -1$) across all coffee-growing regions. The resulting system produces a monthly updated global drought indicator that quantifies the proportion of coffee area currently affected by water deficits.

This monitoring approach provides actionable information for stakeholders, including producers, traders, and policymakers, by identifying emerging drought risks and supporting timely interventions such as adaptive management, financial planning, and targeted support measures.

Keywords: Climate change, climate services, coffee, drought