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Drivers of cocoa yield variability in on-farm trials across major cocoa-producing countries in West Africa

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Abstract

In recent years, concern about the effects of climate change on cocoa production has increased. This concern intensified following the significant decline in cocoa productivity reported during the 2023/2024 season (Bellini Motovska et al., 2024), particularly in Côte d'Ivoire and Ghana (Kongor et al., 2024). This yield decline has largely been attributed to shifts in climatic conditions, including rising temperatures, erratic rainfall patterns, and increased exposure to El Niño events (Ritchie, 2024). Previous studies have shown that cocoa is highly sensitive to climate variability and change, including higher temperatures, irregular rainfall distribution, increased frequency of extreme climatic events (e.g., El Niño), and elevated atmospheric CO₂ levels (Gateau-Rey et al., 2018; Black et al., 2020; Asante et al., 2025). However, management practices have also been identified as major determinants of on-farm cocoa yields (Asante et al., 2021). In this study, we aim to identify the factors associated with cocoa yield variation and assess their potential role in explaining recent yield declines. We analyse data from more than 300 on-farm trials established in 2020 across four major cocoa-producing countries in West and Central Africa: Ghana, Nigeria, Cameroon, and Côte d'Ivoire. We evaluate the effects of management and climate using a hypothesis-driven approach based on cocoa phenology to derive climatic covariates, with harvest date used as a reference point. Detailed data on management practices and fertiliser application were collected throughout the evaluation period (September 2020- September 2025). The objectives of this study are: (i) to identify the main management and climatic factors associated with cocoa yield variation across time and space; (ii) to evaluate the predictive power of these factors in explaining yield variability and yield decline; and (iii) to assess the role of fertiliser application under the observed climatic conditions.

Keywords: Climate change, cocoa yield variability, fertiliser application, management practices, on-farm trials, yield decline

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