- To explain yield variability patterns based on field properties such as plantation age, shade, cocoa tree density, cocoa variety, type of planting material (seedling or vegetative), previous land use, presence of diseases (CSSV, black pod), soil parameters, and elevation. To identify key climatic explanatory variables (e.g. min, max, mean temperature, total rainfall; number of dry months (< 100 mm/month)) together with selected field properties, to explain yield variability across the studied locations Figure 2. Overall yield response to on-farm treatments (T1-T4) in individual countries, demonstrating the STEPWISE logic.

Reduction in number of STs- Not all Satellite Trials provide high-quality results. We initiated a detailed review including visiting the majority of trials and developed selection criteria to exclude STs which have structural problems.

- Criteria included (but are not limited to) disease infestation (e.g. CSSVD), uncooperative farm host, remote plantations, time and skills demands, and budget limitations.
- On this basis, a minimum number of 30 STs per country is proposed to maintain sufficient statistical power.

Satellite Trials Re-design- We would like to re-design the ST treatments so that we can test two additional questions: 1)
What are the effects of N application in mature cocoa fields, and 2) What are options for increased circularity and Integrated Soil Fertility Management. We propose to move towards tailored nutrition strategies for different AEZ and add two new treatments:

- 1. An “organic input” treatment to test options for re-using organic materials such as cocoa pod husks (CPH), pruned branches, recycled as biochar or composts, in combination with inorganic fertilizers.
- 2. An N-omission treatment.

A full proposal for the Satellite Trial revisions will be presented in fall 2025

Further reading & more information

Vasquez-Zambrano et al. (2024) Deriving fertiliser recommendations for cocoa: An offtake model approach

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CocoaSoils

Satellite Trials Fact Sheet July 2025

IITA · CGIAR · Norad · CGIAR Sustainable Farming · Wageningen University & Research

Background

- Smallholder cocoa farmers are constrained by limited resources, resulting in sub-optimal management and the inability to purchase fertilizer.
- On the other hand, the best returns to fertilizer applications are achieved when yield-reducing factors such as pests and diseases are controlled.
- The CocoaSoils Satellite Trials allows the field testing of the STEPWISE approach, breaking GAPs into manageable, incremental investments.
- We used an additive approach of four plots (T1–T4) representing increased intensities of management and investment (STEPWISE) initially on about 389 cocoa plantations beginning in the main season of 2020 in Cameroon, Côte d'Ivoire, Ghana, and Nigeria.
- The experimental design allowed assessment of the individual and interactive effects of density, shade and fertiliser following the STEPWISE approach (Figure 1).
- The T1 (control) was managed as usual by the participating farmer.
- T2 entailed applying all the best agronomic management practices except fertilizer application (GAP).
- T3 included all GAPs as in T2, plus the application of the nationally recommended fertilizer in each country (GAP+NF).
- In T4, GAPs were applied plus fertilizer based on the estimation by an offtake model, which calculates the nutrient requirements of the cocoa trees to grow roots, stems branches, leaves and pods, using nutrient uptake data and allometric relations from empirical measurements (GAP+OF).
- The differences between the national recommendations (GAP+NF) and the off-take model rates (GAP +OF) are country-specific. However, in most cases, the quantity of N and K is higher in the off-take model, with P applications being similar.

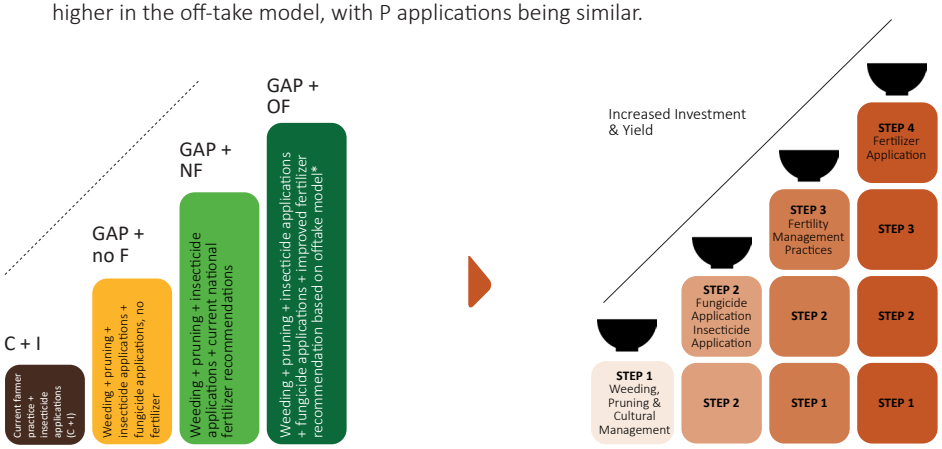

Figure 1: Overview of the Satellite Trial treatments, following the STEPWISE logic.

Key findings

- In most countries, more N and K are applied in T4 than in T3, but P applications are similar.
- There is incremental yield gain from T1 to T4- the offtake model resulted in higher yields than the national fertilizer
- Fertilizer had on average, a significantly positive effect on cocoa bean yield, but both bean yields and fertilizer responses differed significantly between countries and were significantly affected by the cocoa tree density in the plot.
- Control (CT) and GAPs treatments did not differ significantly (Figure 2). This appears to be because farmers already apply many GAP activities.
- Within countries, agroecological zones had a significant effect on productivity.
- Working in farmers' fields creates many challenges which are both technical (determining and controlling experimental factors) and operational (carrying out the needed activities to the required level of precision and and accuracy at the right time).

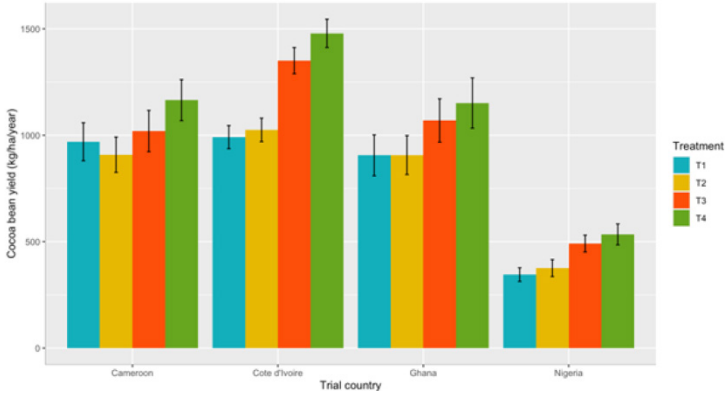

Figure 2. Overall yield response to on-farm treatments (T1-T4) in individual countries, demonstrating the STEPWISE logic.

Way forward

Technical Validation of Results Cocoa plantations are characterized by extreme heterogeneity-genetic, age, terrain, microclimate due to irregular cover, and management. Ongoing statistical analysis seeks to elucidate the main variables that determine differences in yields and yield responses, focusing on yield gain and profitability. This analysis aims:

- To evaluate the effect of treatments on yield components (bean yield, pod count, pod weight) and vegetative growth (e.g. tree diameter, tree height, canopy cover) across locations and time.