



CocoaSoils



On-farm testing of GAPs x fertilizer combinations in existing cocoa plantations (Satellite trials)



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Presentation outline

- STs trial design consideration
- Step-wise concept
- STs trial field implementation
- Preliminary results
- Thoughts on second-generation trials



Satellite trials -

- established in existing cocoa plantations
- to test different fertilizer combinations and shade interactions to examine the effects on yield under field conditions.
- managed by **company technicians** and farmers



**But why do we worry about testing
under real farm conditions?**

Our baseline study.....

Up to 50% of farmers were not using fertilizer

Among those who used, they did not apply the recommended rates

Farmers were not achieving the best management (weeding, pruning, pest and disease control)

Real farms....

Smallholder farmers face severe resource limitations



Sub-optimal application of BMPs
(inability to purchase fertilizer)



Wide yield gaps



Real farm (plantation) conditions

- Farmers at different stages on the development pathway
- Efficiency varies across ecological zones, farms and fields within farms and greatly affects productivity
- Many other confounding factors – edaphic, environmental, and management



What is stepwise approach?



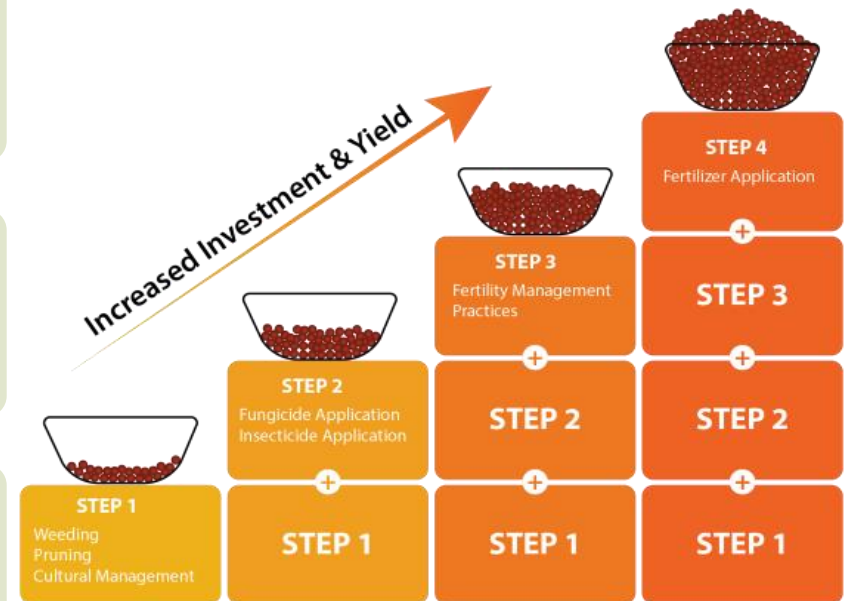
Stepwise approach breaks down the recommended best practices that many farmers cannot afford to implement at once:



Smaller, more affordable packages

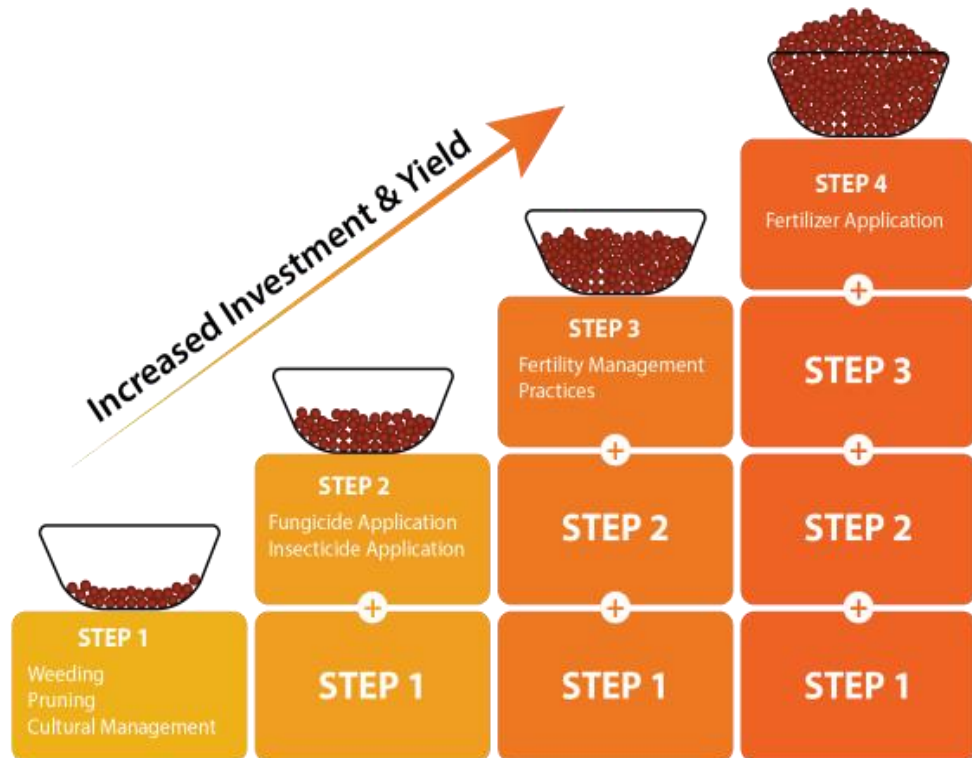


Can be implemented in phases to enhance adoption of agricultural technologies.

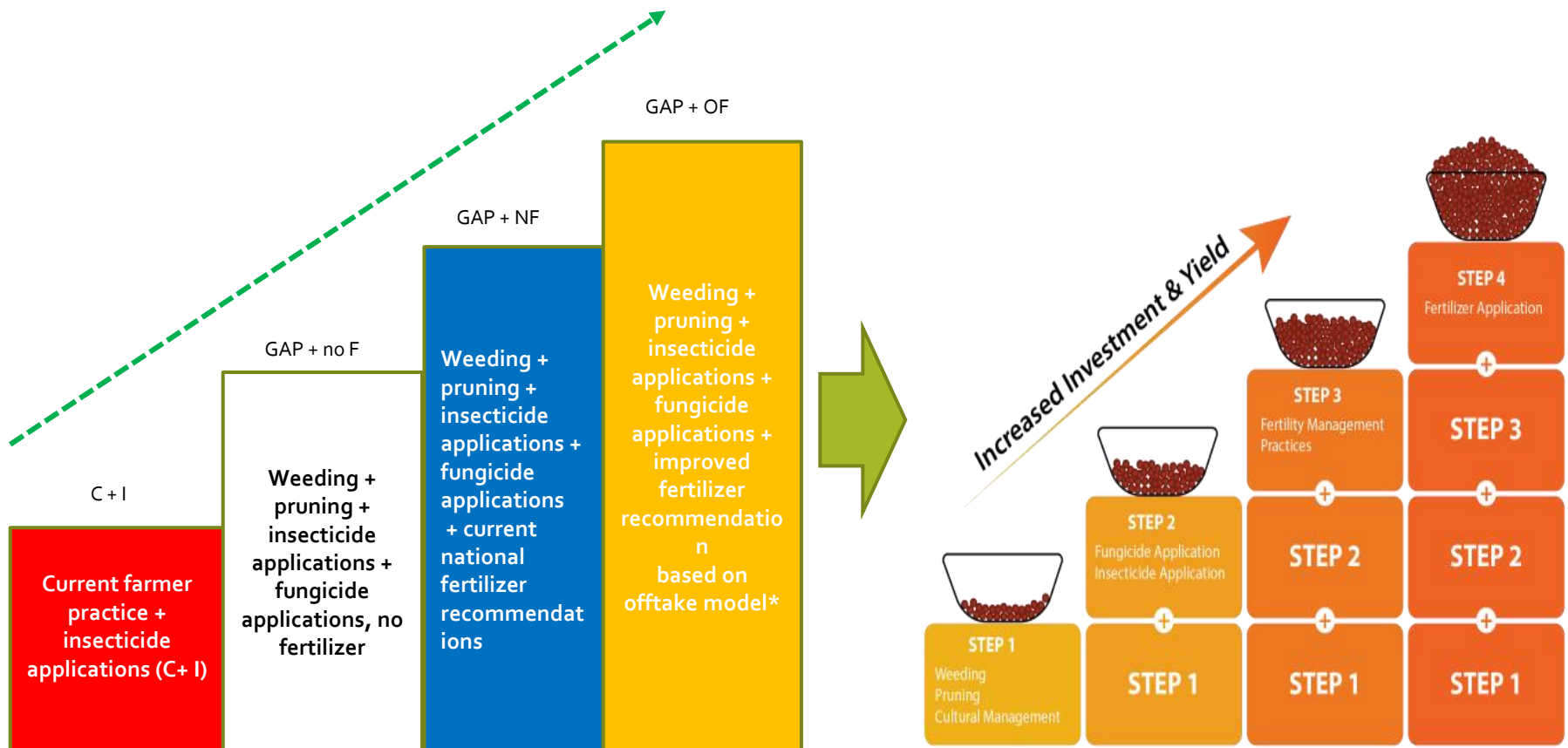


A stepwise approach – where to start?

- Farm diversity largely driven by land and other resource limitations
- What are the investment needs and the outcome, and for whom?



A stepwise approach – satellite trials



- **An additive approach of four plots (T1-T4) representing increased intensities of management.**

Field design considerations



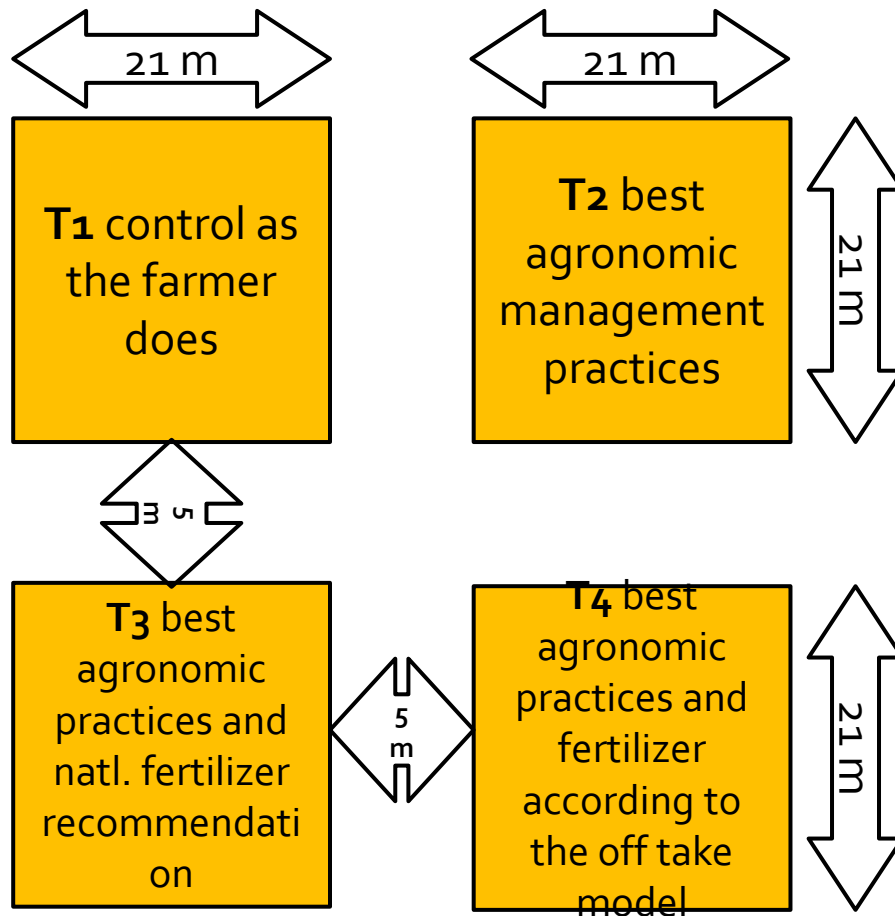
Restricted density, (950 - 1900) trees per hectare

Restricted age (8- 22) years, age of most trees in a plantation

Shade level – was considered as a continuous variable

- **Management status of plantations?**
- **AEZ?**

Plot arrangement on flat land with homogeneous shade

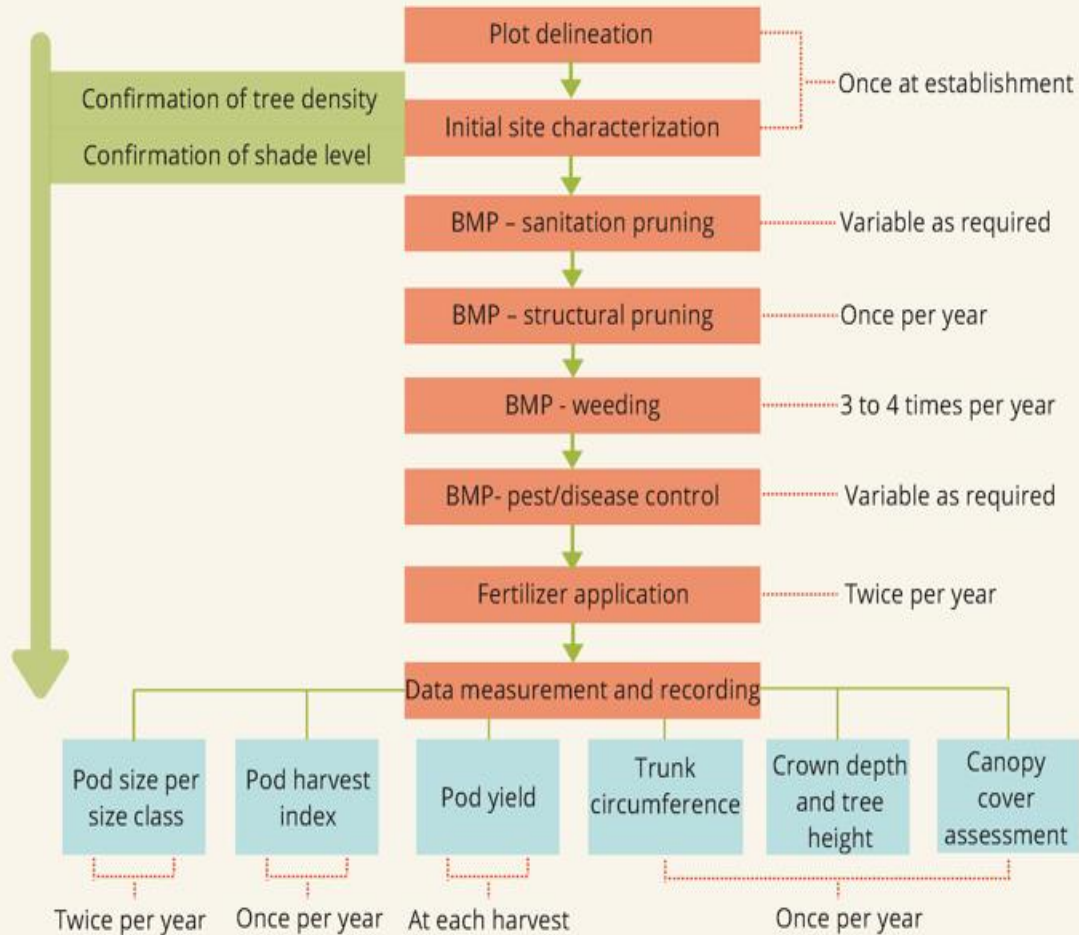


The distance between plots of 21 by 21 m needs to be a minimum of 5 m.

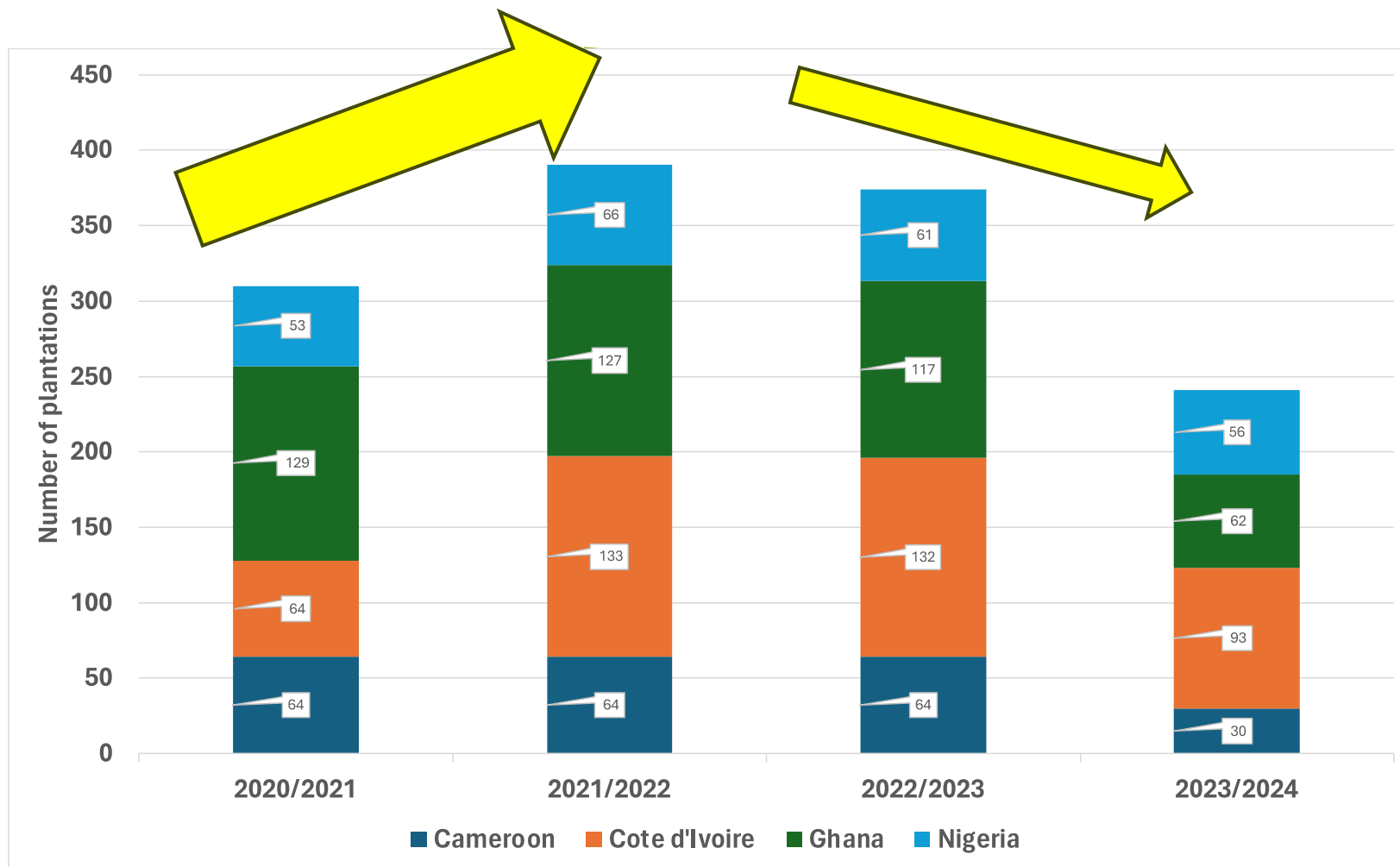


STs trial field implementation

Satellite Trials Activity Sequence



Distribution of Satellite trials – numbers evolution



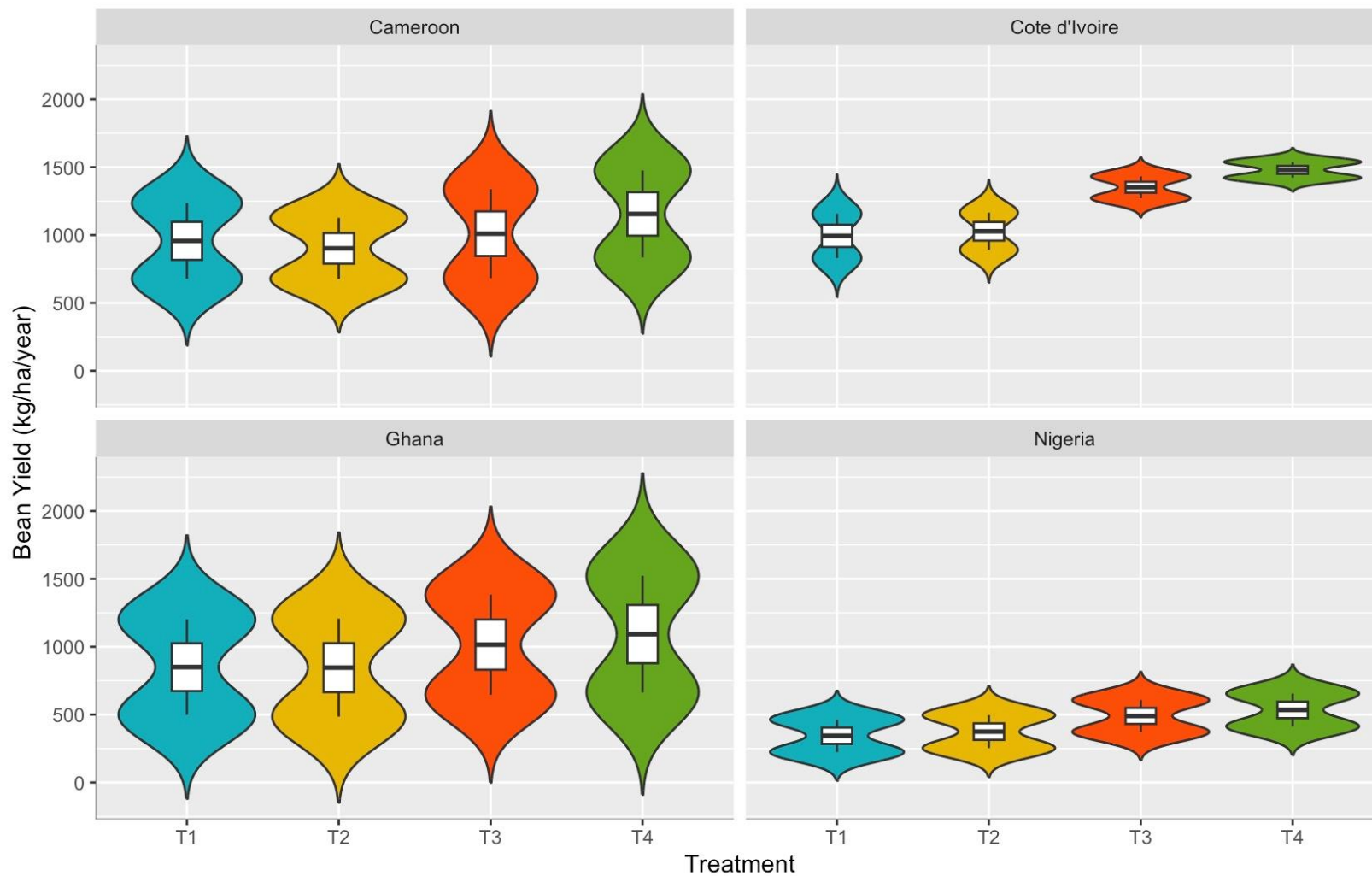
Preliminary results - ANOVA



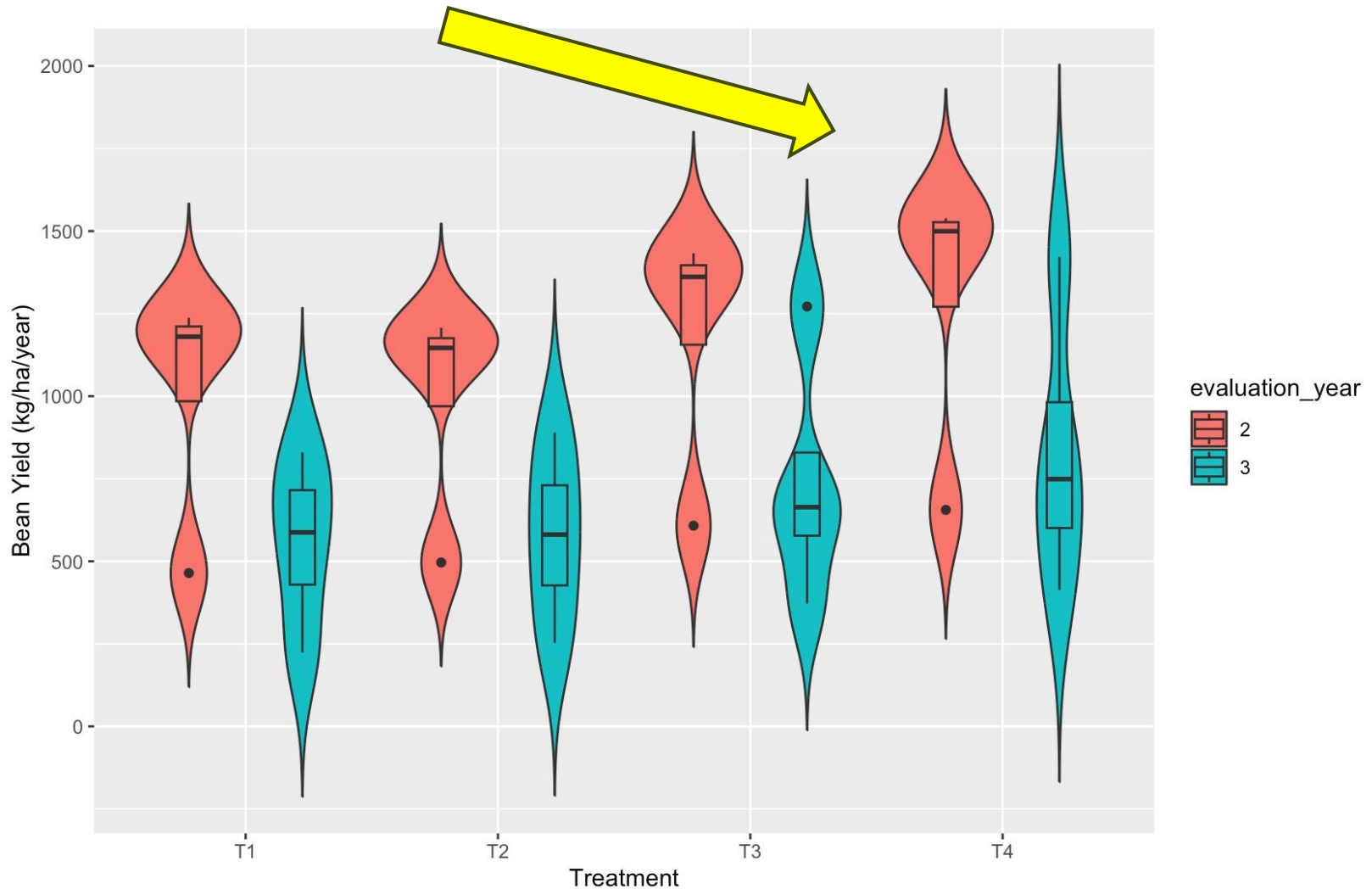
Source	SS	MS	DF	F	p-value
Trial country	942519	314173	3	3.7	*
Shade tree density	236531	236531	1	2.8	ns
Plantation age	154070	154070	1	1.8	ns
Cocoa tree density	2329934	2329934	1	27.6	***
Treatment	11959266	3986422	3	47.3	***
Trial country: Treatment	2475542	275060	9	3.3	***
Shade tree density: Treatment	173676	57892	3	0.7	ns
Plantation age: Treatment	99047	33016	3	0.4	ns
Cocoa tree density: Treatment	137206	45735	3	0.5	ns

- **The effects of treatment, cocoa tree density and shade tree density had a significant effect on cocoa bean yield.**
- **The effect of treatment, however, was different among the countries.**

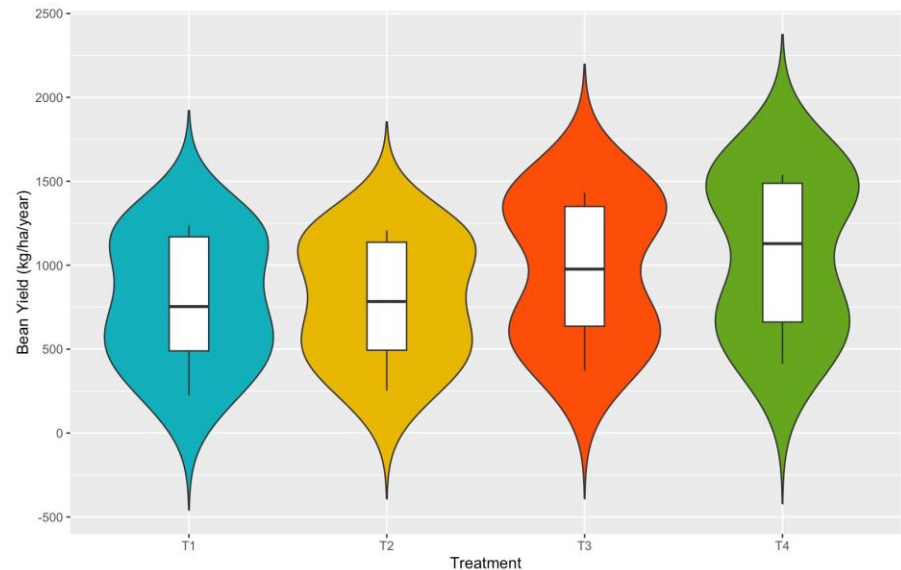
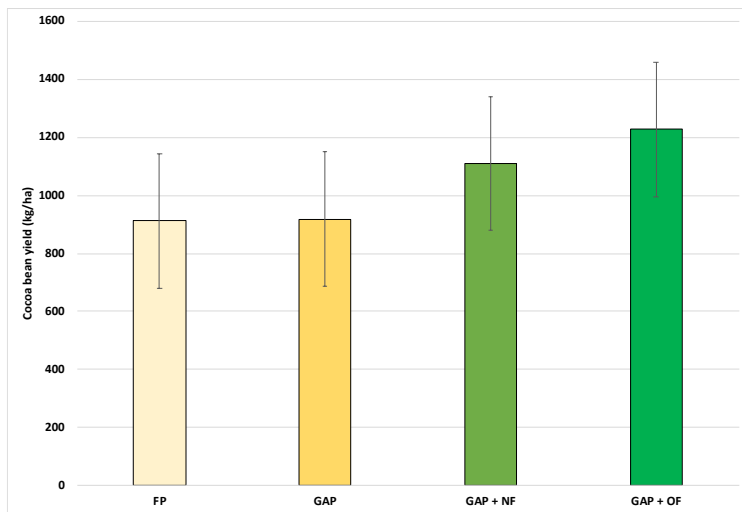
Summary by country



Yearly comparison



Overall cocoa yield response to fertiliser treatments



- Results prove the "STEPWISE" concept (based on 2 full years)

Reasons for T₄ superiority -



Country	National recommendations (kg ha ⁻¹ year ⁻¹)			Model 1000 kg yield, 8-22 YAP (kg ha ⁻¹ year ⁻¹)		
	N	P	K	N	P	K
Cameroon	0	22.3	35.0	58.5	46.1	96.3
CdI	0	33.5-44.7	52.6-70.1	58.5	46.1	96.3
Ghana	0	26.0	59.1	58.5	46.1	96.3
Nigeria	60.0	21.8	52.6	58.5	46.1	96.3

- Generally, more nutrients are applied via T₄
- N applied
- Better nutrient balance – N:P:K ratios

Development of decision support

- Work in progress

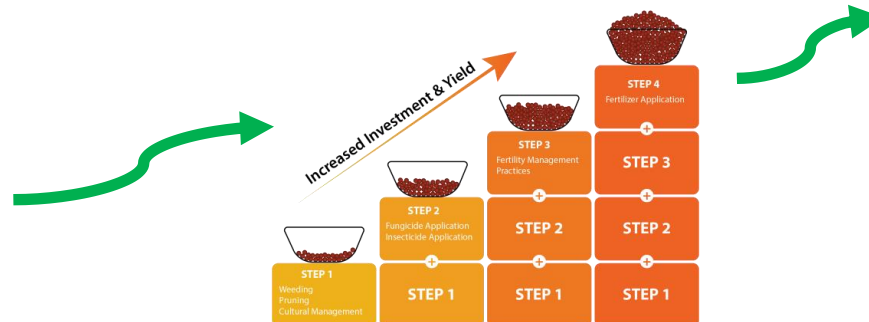
- Prototype with developer/engineer
- Further analytics and validation

Advisory apps/ field guides

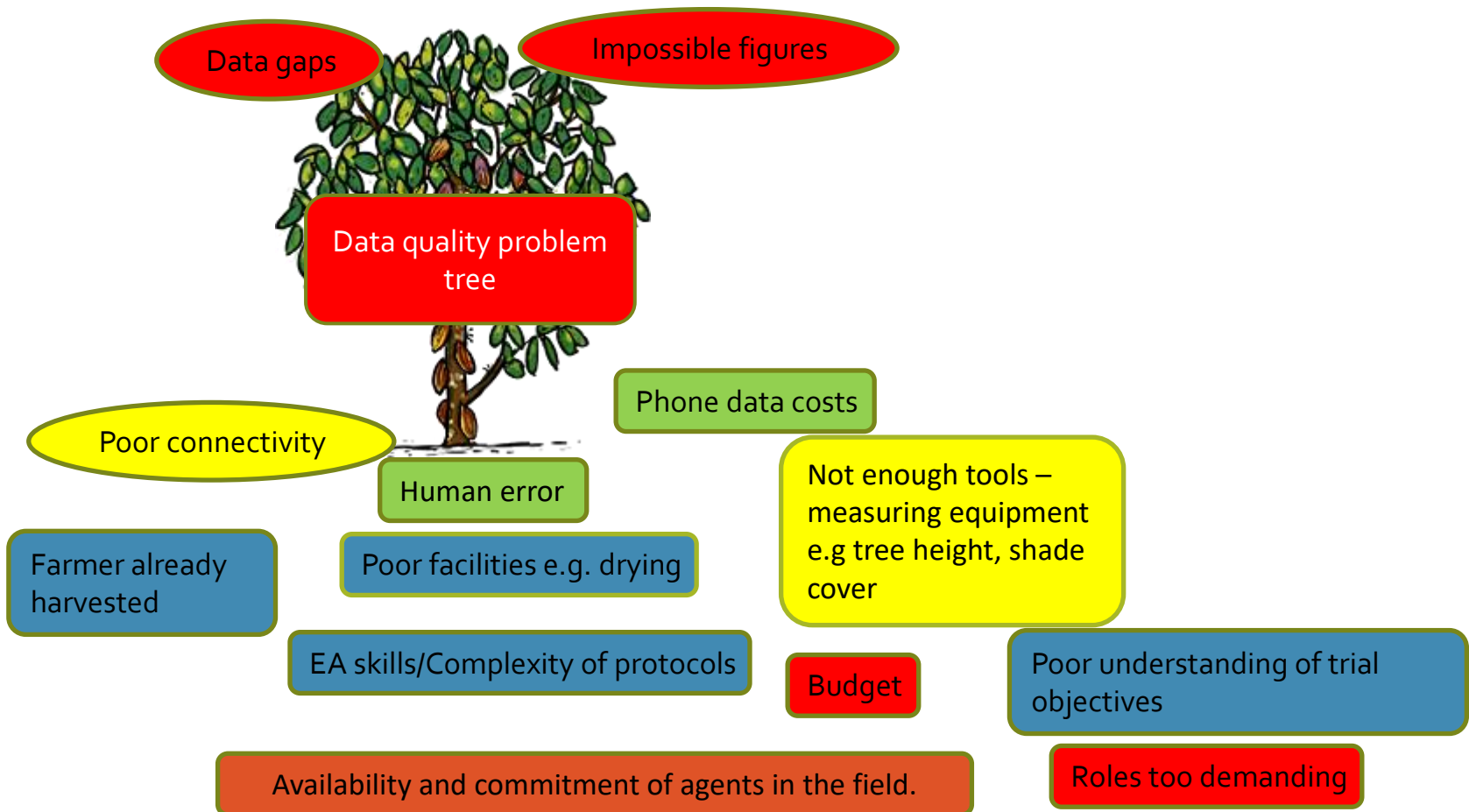
Field trials



Analytics:




Challenges in implementing STs





Thoughts on 2nd generation trials

- Fewer manageable numbers? 10 per country?
- Treatments –
 - 100% T₄ ,
 - 50% T₄ and organic resources,
 - 100% organic (compost+)
 - 100% compost + biochars



Satellite trials - modifications

Drop T₁ – considered redundant

- Consider a treatment with organic only (compost, organics)
 - Must be available at the farm
- Consider a treatment with fertilizer products on the market especially coming from CocoaSoils partners
- How about a plot with half dose of the full recommendation, given the high cost of fertilizers?
- Use climate information systems to optimally time yield operations (GAPS, fertilizer)
- Use lessons from trials from Biochar project (Reading, CRIG, KNUST) to inform future treatments



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Thank you!

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