CocoaSoils

CocoaSoils: highlights of achievements and key learnings

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*For and on behalf of the whole CocoaSoils Team

Presentation outline

- Background and context
- CocoaSoils Program design
- CocoaSoils activities and achievements
- Looking ahead

Background - nutrient management in cocoa

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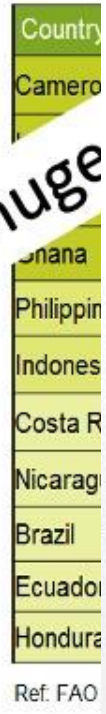
THE CHALLENGE

- Global demand for cocoa increases 2-3% per year
- About 70% of global supply originates from West Africa smallholders (<5 ha)
- Yields are poor (1… potential). A… …n yields in West … …between 300 and … …beans per ha
- … …d harvests in trials and …st' farmers up to 3t/ha/yr

Cocoa yields stagnated – huge



Ref: FAO

Conclusion of the Cocoa Fertilizer Initiative

- There is a fundamental knowledge gap on cocoa nutrition that will haunt us forever unless we address it now!

A public-private partnership

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Consortium

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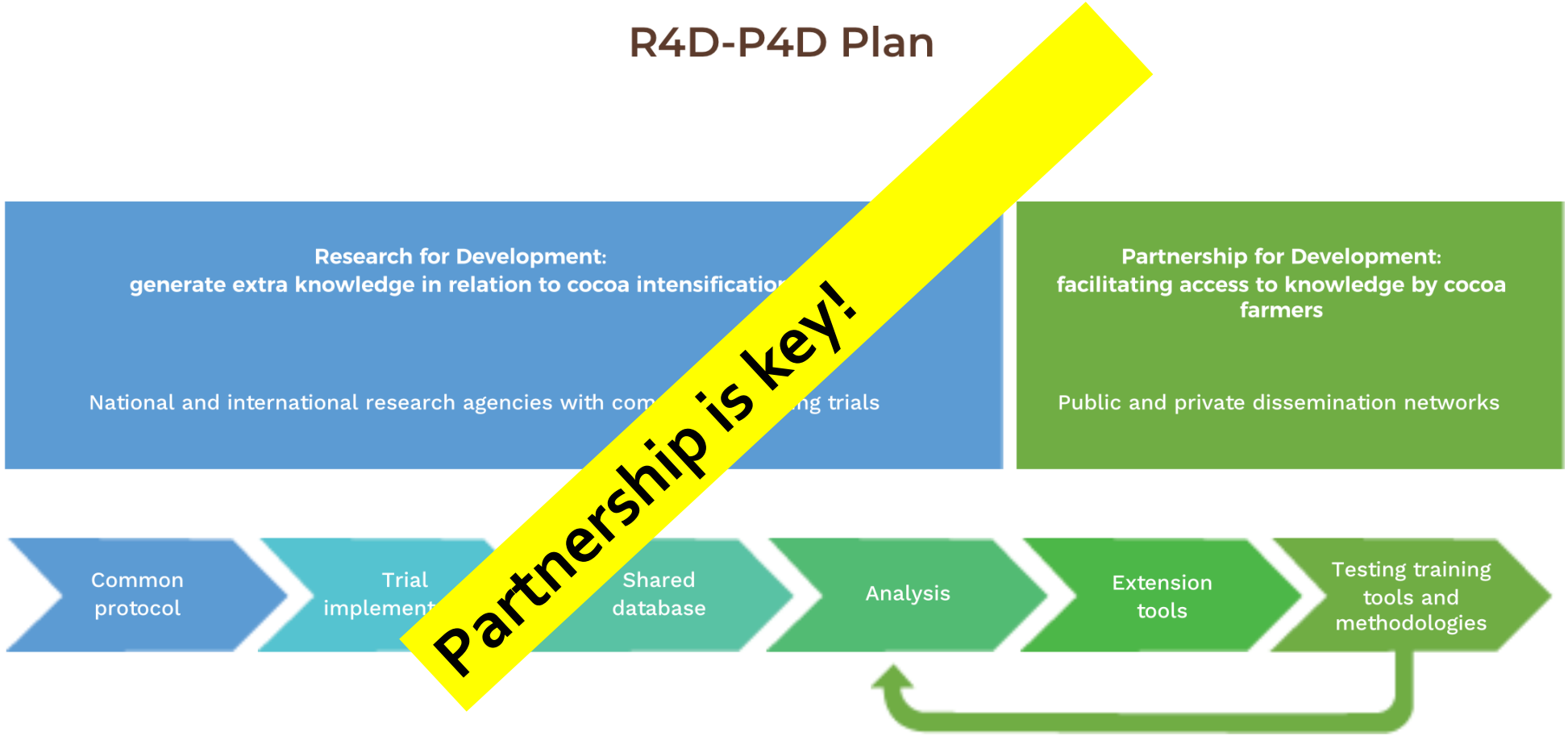
Program coordinators	idh transforming markets; IITA Transforming African Agriculture; WAGENINGEN UNIVERSITY & RESEARCH
(Co)-funders	Norad; PRIVATE SECTOR
National Agronomic Research Centers	COCOA RESEARCH INSTITUTE OF GHANA NEW TAFO - AKIM; COCOA RESEARCH INSTITUTE OF NIGERIA CRIN; IRAD; CNRA CENTRE NATIONAL DE RECHERCHE AGRONOMIQUE; espol Escuela Superior Politécnica del Litoral
International Research Centers	UN environment; WCMC; Alliance: Bioversity International, CIAT International Center for Tropical Agriculture Since 1967 Science to cultivate change; World Agroforestry Centre
Industry Partners	Nestlé; Cargill; Mondelēz International; World Cocoa Foundation; Kuapa Kokoo Papa Paa; ICL; Rockwinds; S&D SUCDEN; Olam; MARS incorporated; BARRY CALLEBAUT; YARA; OLATUNDE INT'L LTD. RC 246410; Tulip Cocoa

CocoaSoils workflow



CocoaSoils objectives

1. **A set of integrated soil fertility management options:** Guidelines have been developed to promote replacement of the nutrients that are removed from the field to avoid soil mining. A fertilizer response model is being established following the QUEFTS principles. It will work in more than 80% of the tropical soils where coc… tivated and allows fertilizer recommendations to be developed.

2. **Understanding the physiological basis of cocoa nutrient uptak…** …f different cocoa genotypes to nutritional treatments and the interactions with sh… …actions between potassium nutrition and drought stress will receive spec… …to climate change.

3. **A decision support system f…** …d with prospective users (extension agents a… …imate and contributing to forest co… …y management within a ge…

4. **Ide… wil…** …**ure: Four key activities**

   2. … an agroecological zone approach.
   3. …tion packages and interventions on overall cocoa …
   4. …ion scenarios on forest protection and deforestation.

5. **A susta… …ol:** A tool is being developed to assess the implications of different scenarios for CSC for biodiver… …ystem services. Outcomes of the analyses will be discussed during multi-stakeholder workshops involving …ers, businesses, civil societies and governments.

6. **An open knowledge and data sharing portal:** An open data and knowledge sharing portal is being established to bring all background research and knowledge on cocoa

A sustainable cocoa supply sector with increased productivity of cocoa farms (25%), efficient use of agricultural inputs and improved rural livelihoods (90,000) while avoiding deforestation

Field trials – approach and results

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- **Two sets of field trials**

- Multi-nutrient, multi-locational reponse trials generally referred internally as CORE trials

- Simple 4-plot trials in established plantations plantations, generally referred to as Satellite trials

Fertilizer treatments: Off-take model approach

- ***To calculate cocoa nutrient requirements on the basis of nutrient offtake rates + expert opinion***
  - The *off-take model* calculates the nutrient requirements of the trees to grow roots, stems branches, leaves and pods, using nutrient data and allometric relations from empirical measurements.
  - Based on the principle of replacement i.e., the nutrients added in fertilisers should replace the nutrients leaving the soil system.
  - The offtake model considers inputs from rainfall as well as losses from erosion, run-off, leaching (in kg/ha/year).

Global network of large multi-factorial cocoa nutrient response trials established since 2018

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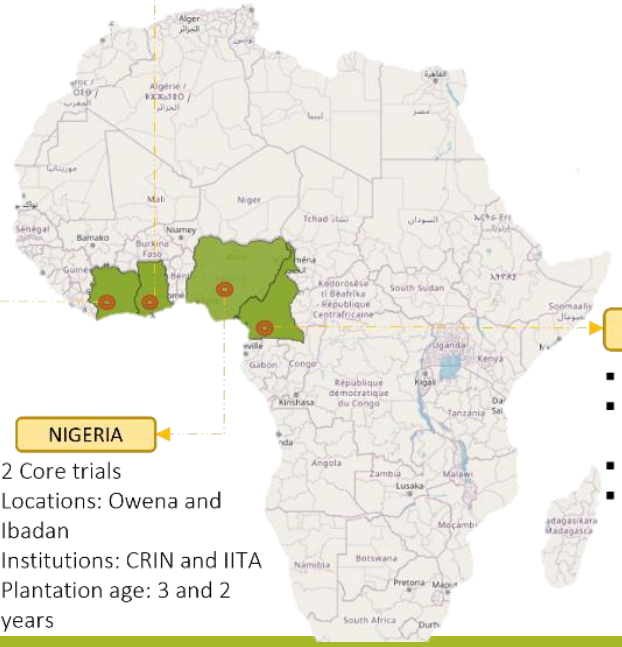
ECUADOR

- 1 Core trial
- Located in Quito
- Institution: MARS and ESPOL
- Plantation age: 2 years

GHANA

- 2 Core trials
- Locations: Maabang and Buako
- Institutions: CRIG and Mondelez
- Plantation age: 3 and < 1 years



COTE D'IVOIRE

- 3 Core trials
- Locations: Divo, Tiassale and Aboisso
- Institutions: CNRA, Barry Callebaut and Nestle
- Plantation age: 2 years (all)

NIGERIA

- 2 Core trials
- Locations: Owena and Ibadan
- Institutions: CRIN and IITA
- Plantation age: 3 and 2 years

CAMEROON

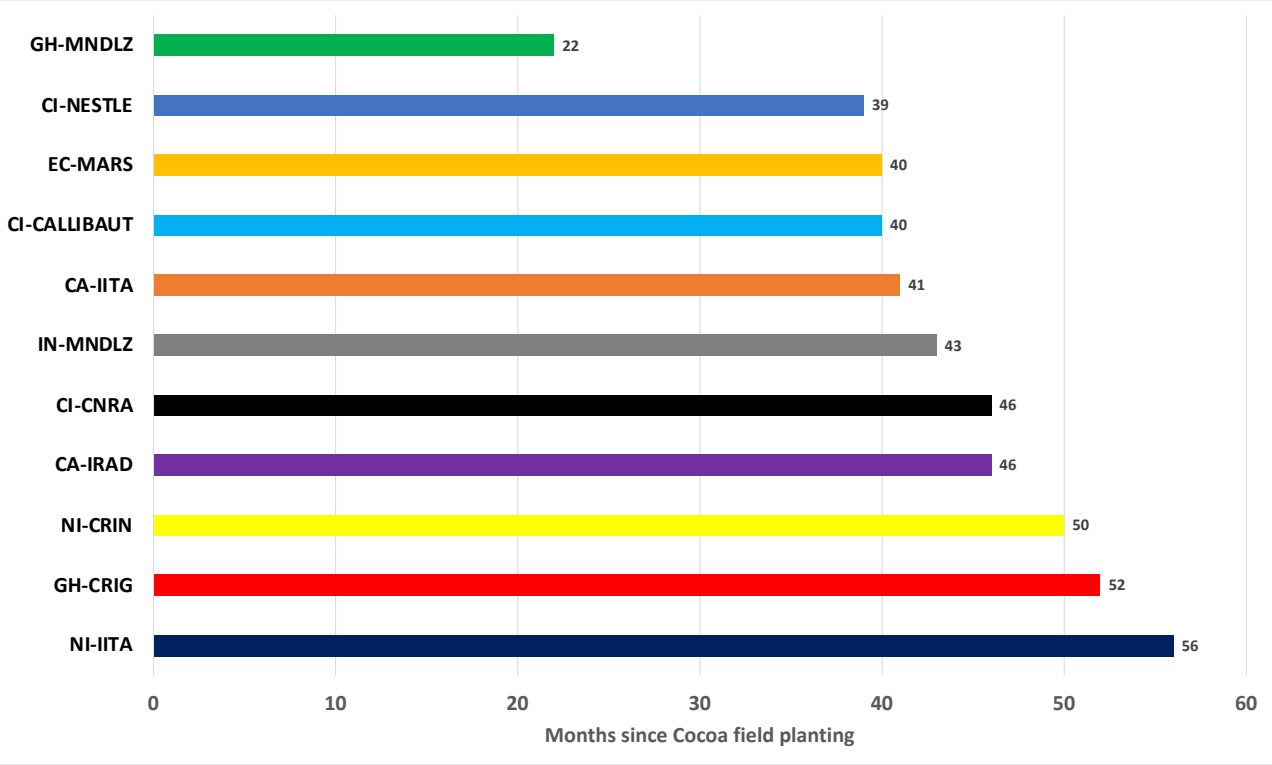
- 2 Core trials
- Locations: Nkoemvone and Mbalmayo
- Institutions: IRAD and IITA
- Plantation age: 2 years (all)

INDONESIA

- 1 Core trial
- Located in Jember
- Institution: Mondelez
- Plantation age: 2 years

Huge infrastructure (2018 – 2024) - Core trials

- All the 11 CTs are running, and data is being collected depending on age since establishment



Data collection protocols in Core trials

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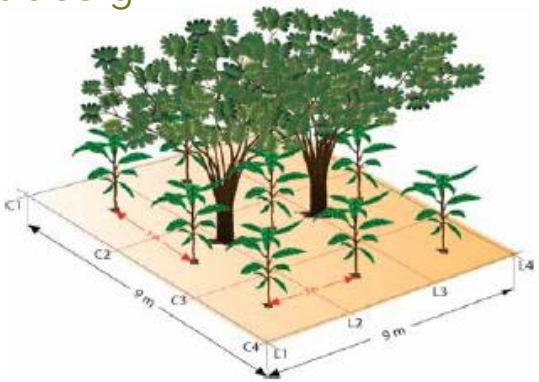
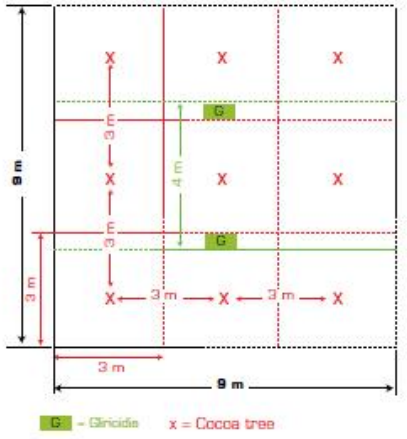
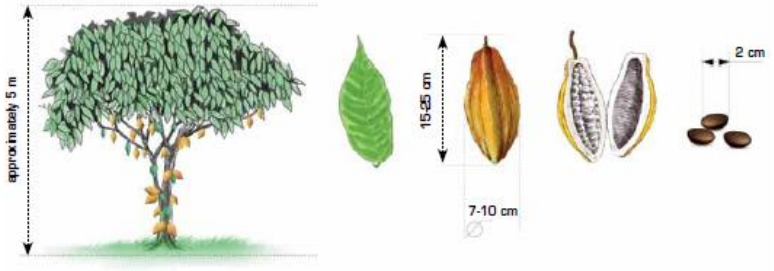
- Plot design



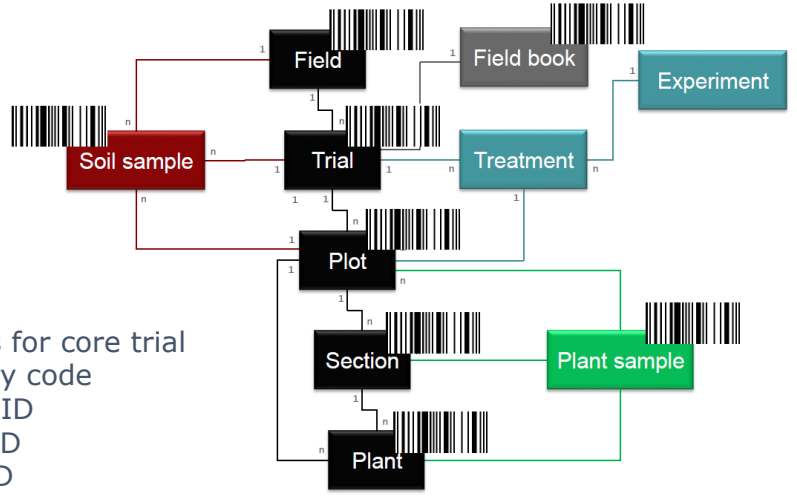


- Cocoa trees

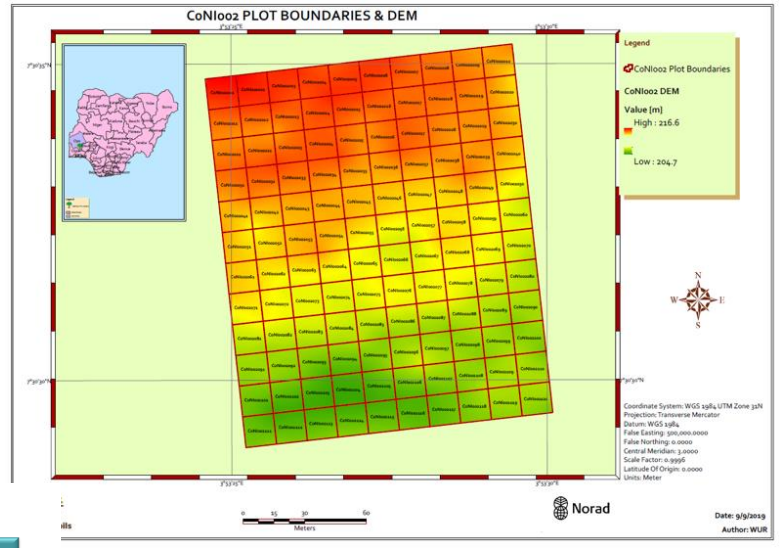


- Labelling

- C0 => stands for core trial
- NI => Country code
- 001 => Field ID
- 007 => Plot ID
- 25 => Tree ID

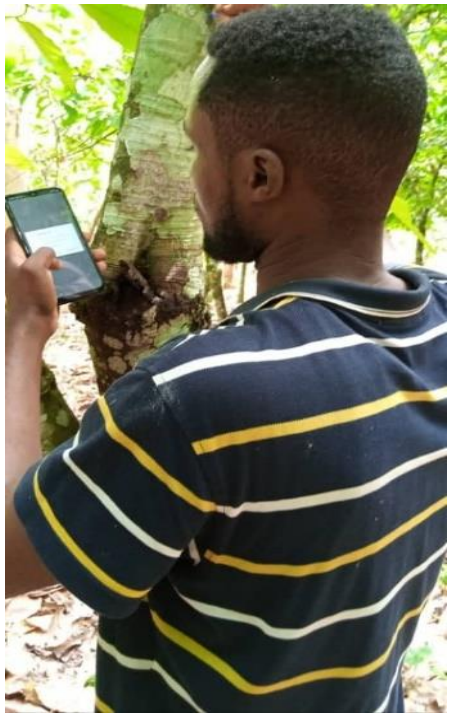


- Spatial map generation



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



What is STEPWISE approach?

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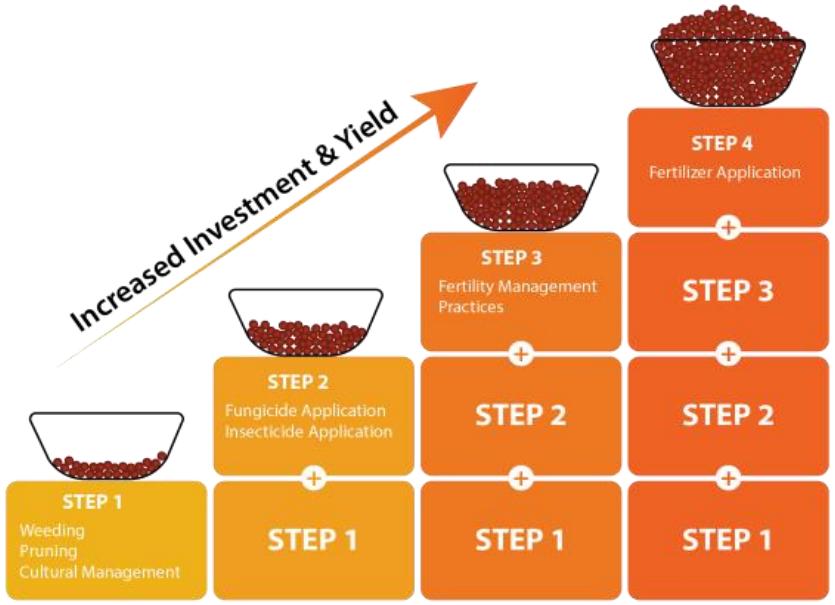
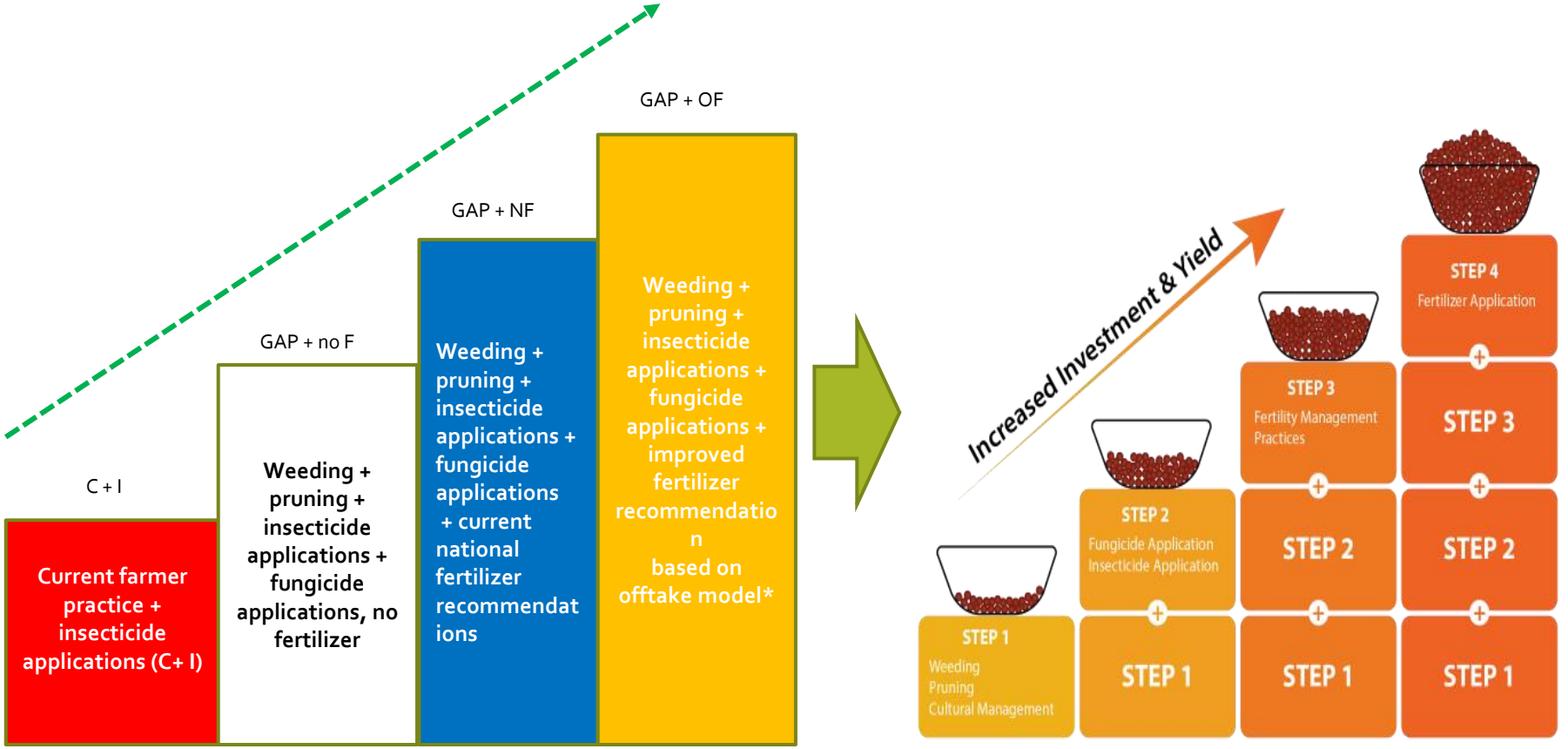
Stepwise approach breaks down the recommended best practices that many farmers cannot afford to implement at once:

Smaller, more affordable packages

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

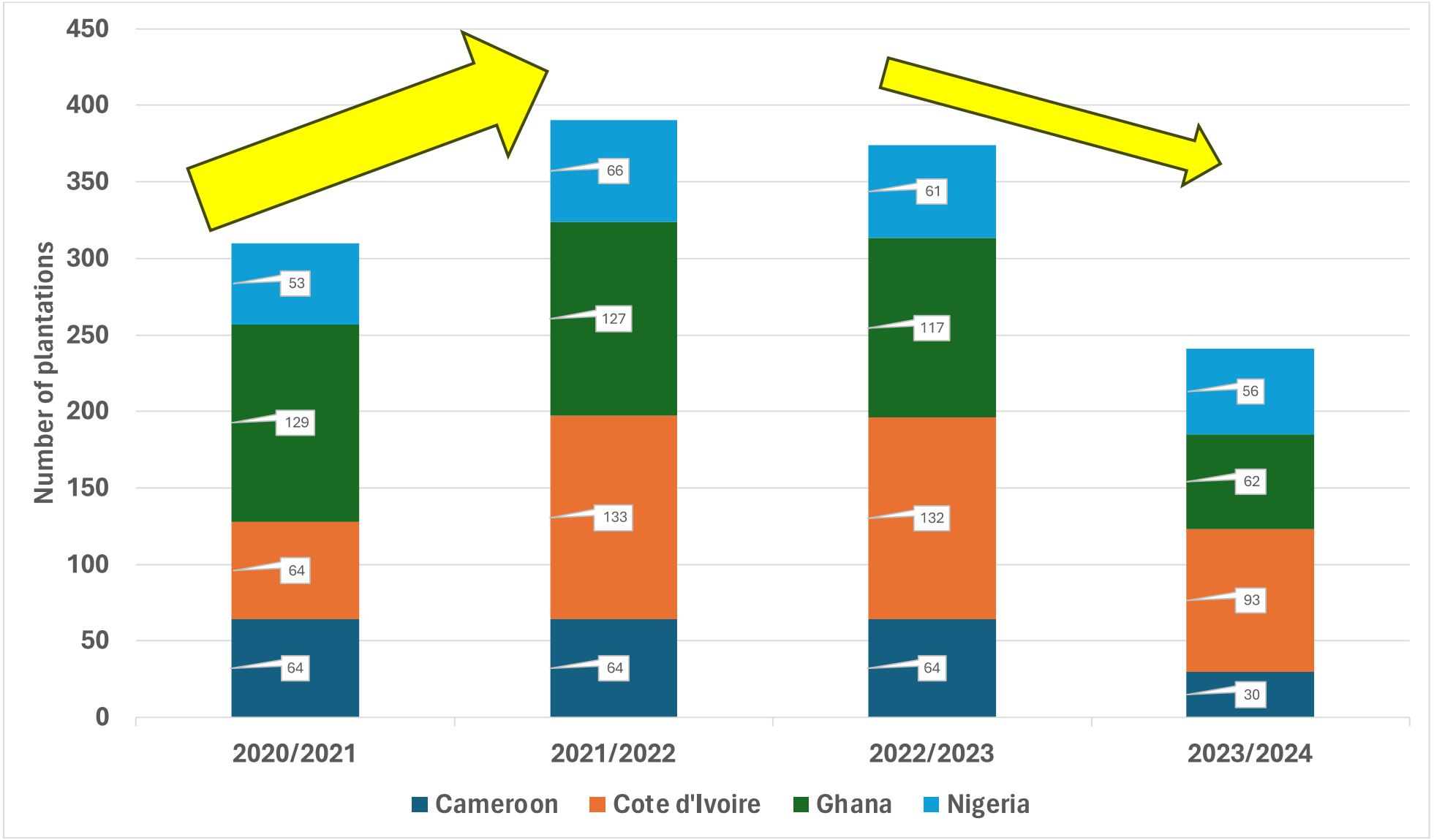


A stepwise approach – satellite trials



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

Distribution of Satellite trials – numbers evolution



Preliminary results - ANOVA

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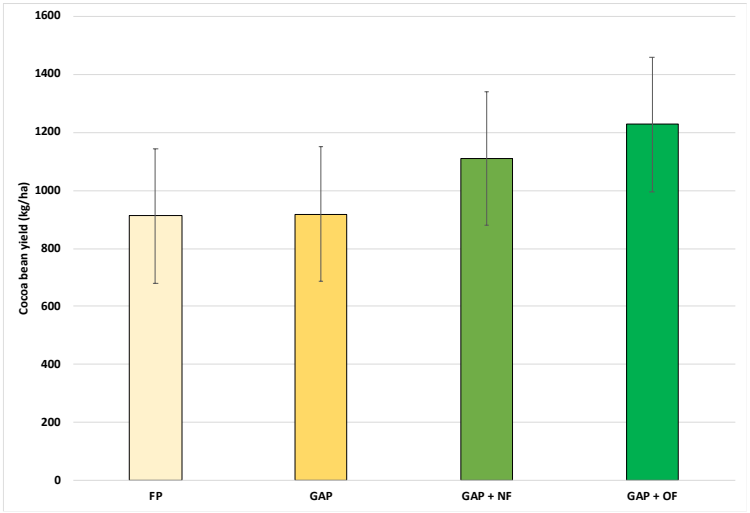
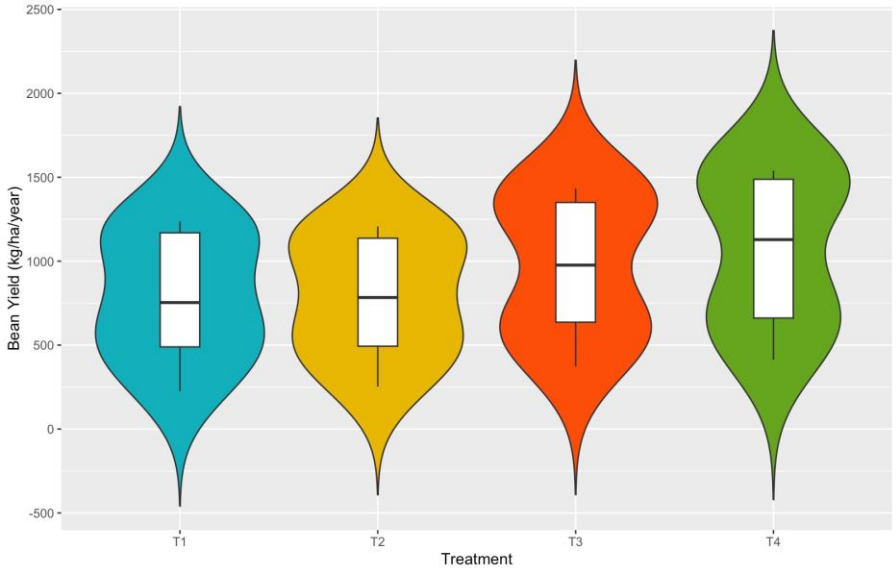
Source	SS	MS	DF	F	p-value
Trial country	942519	314173	3	3.7	*
Shade tree density	236531	236531	1	2.8	ns
Plantation age	154070	154070	1	1.8	ns
Cocoa tree density	2329934	2329934	1	27.6	***
Treatment	11959266	3986422	3	47.3	***
Trial country: Treatment	2475542	275060	9	3.3	***
Shade tree density: Treatment	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.**

Overall cocoa yield response to fertiliser treatments





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

Statellite trials – Harvesting of 2nd main season

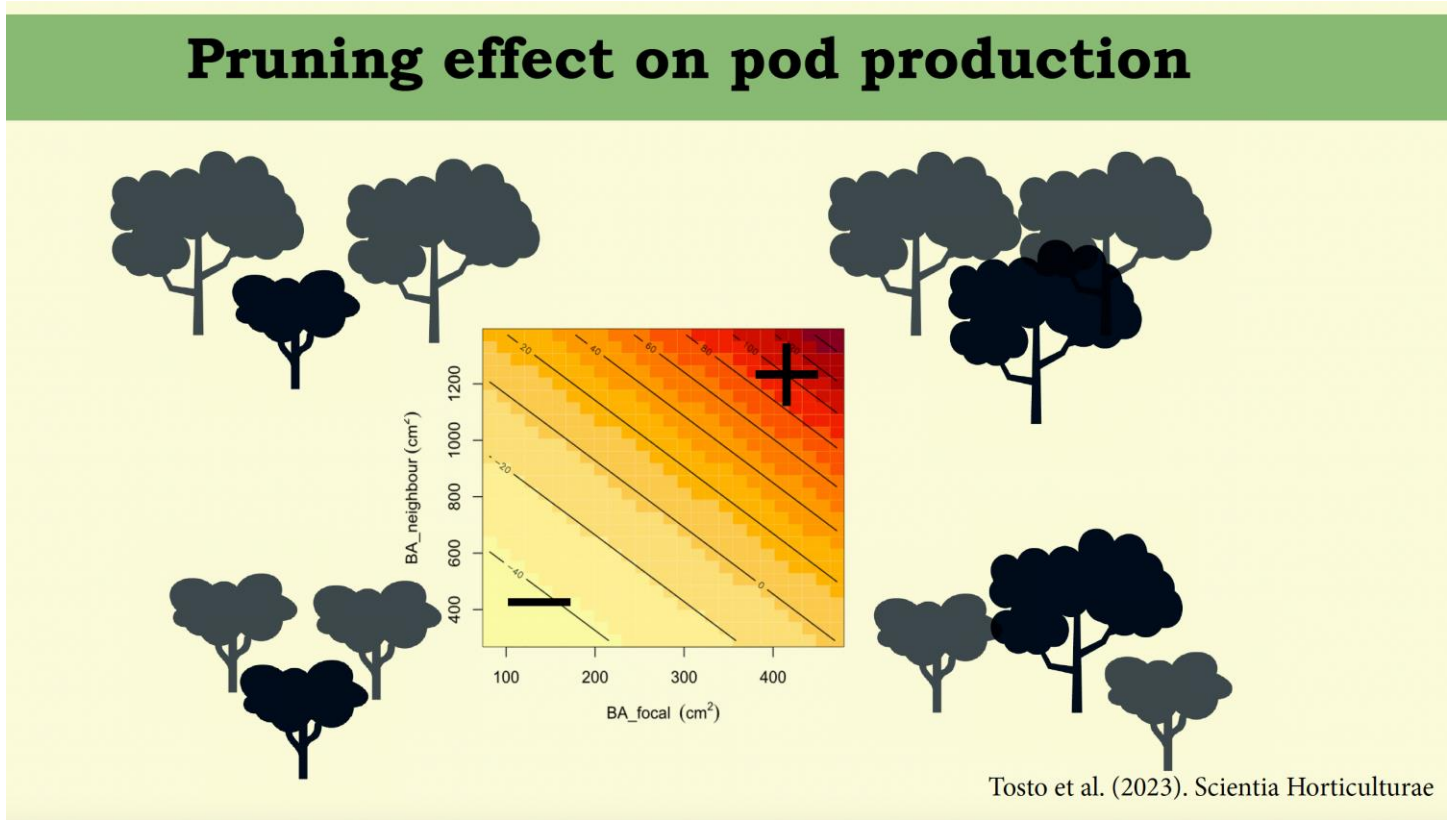
Farmer practice

GAP

Local fertilizer recommendation

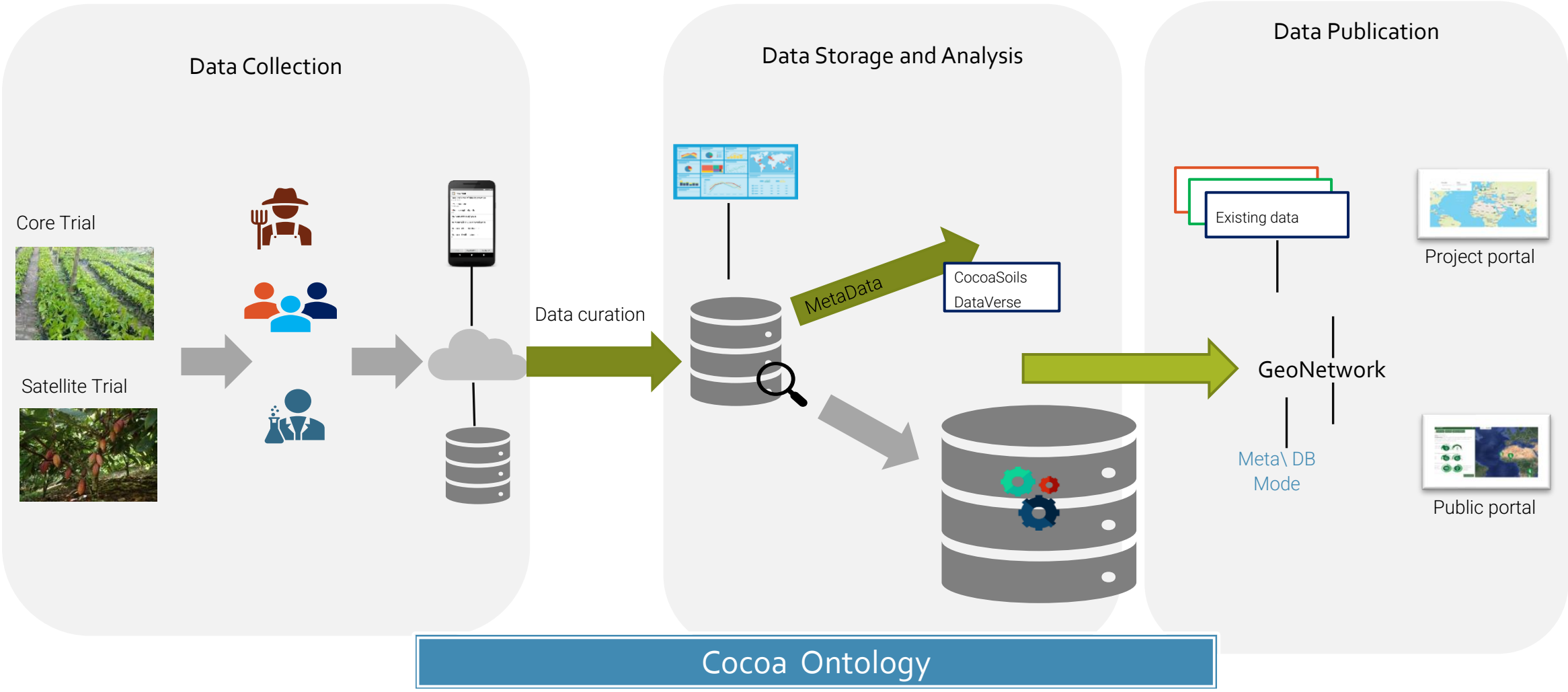
Offtake model recommendation

Notable findings on BMPs…..



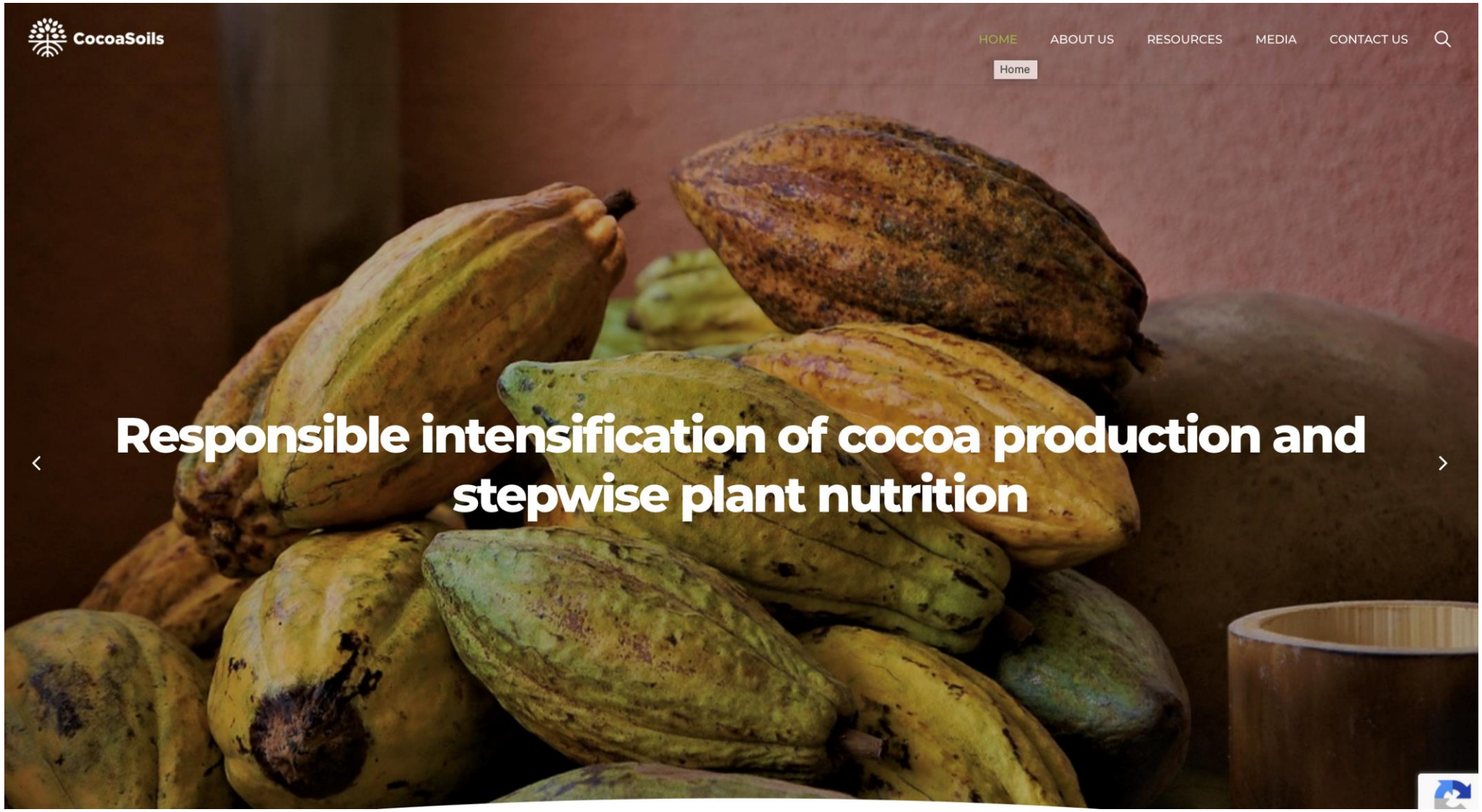
- Pruning is both a science and an art
- Better to target larger trees for a positive effect on productivity
- Pruning better be carried out by skilled farmers/ personnel

Ecosystem of data services

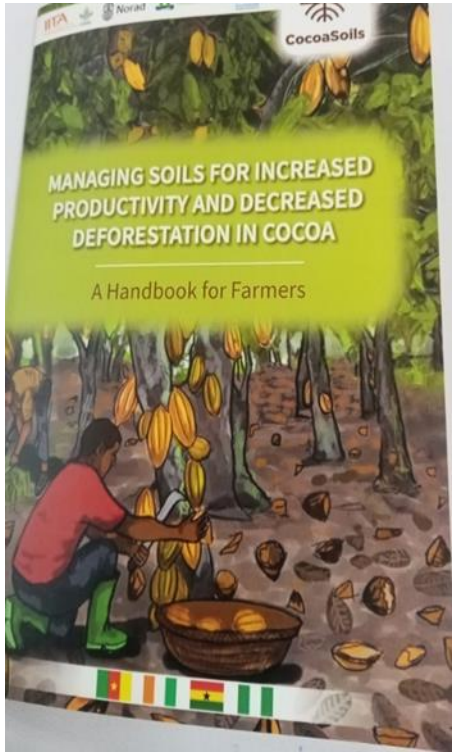


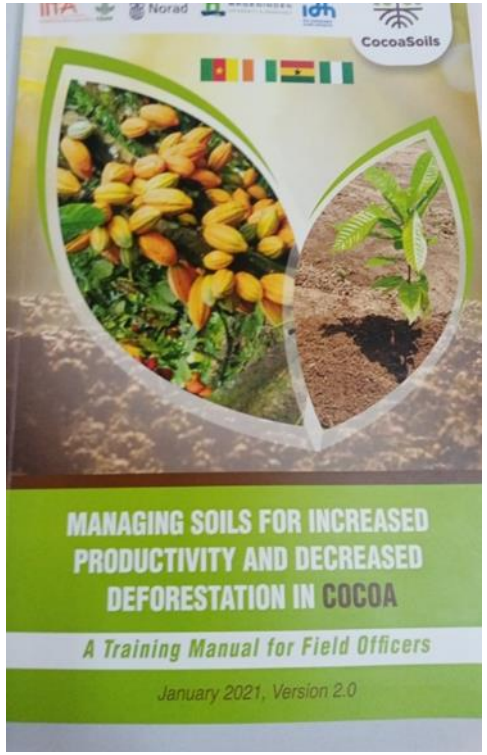
- **Data access credentials have been shared with companies for easy access**

CocoaSoils website: https://cocoasoils.org



Extension-led scaling





Manuals for Extension-led Scaling

Content of Manual

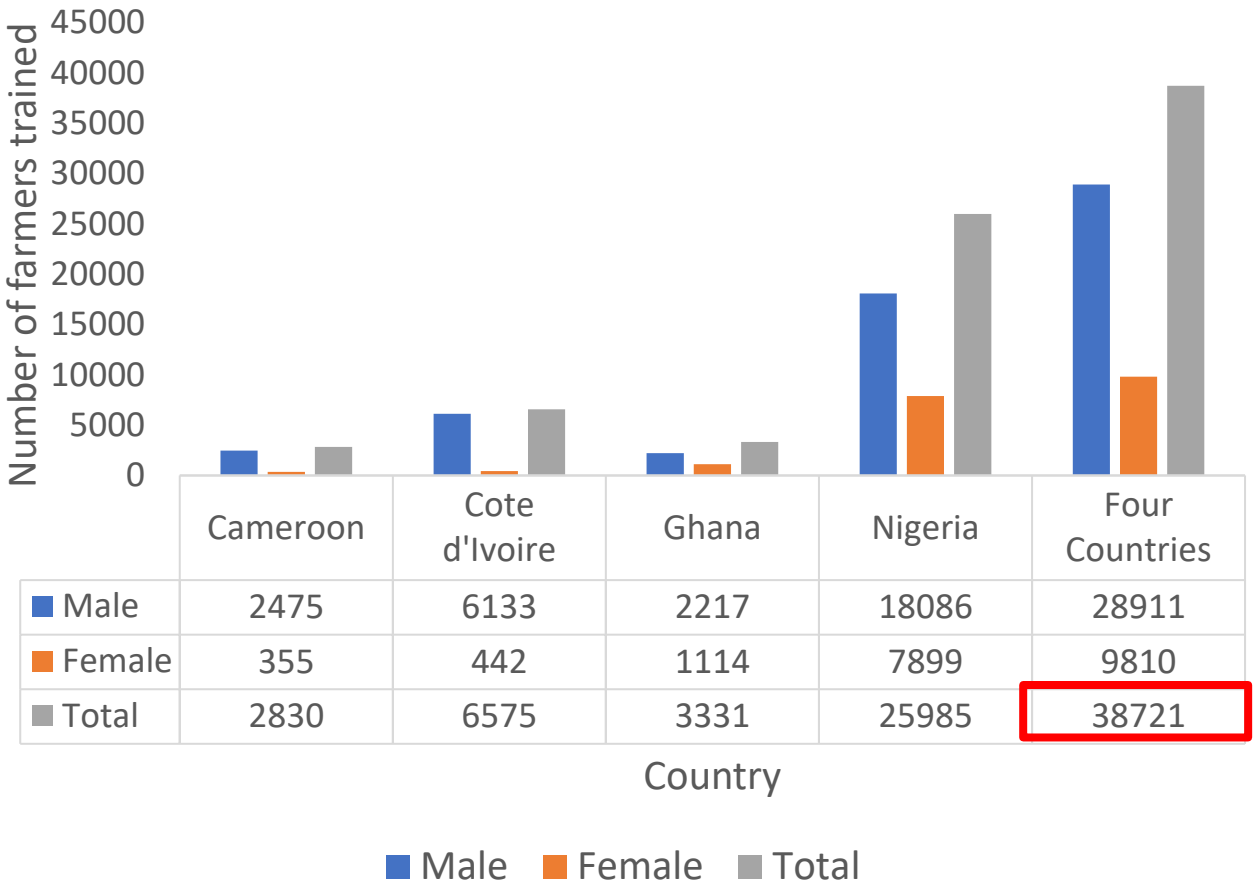
- Productivity and Deforestation
- GAP to increase productivity
- Pruning for Improved Soil Fertility and Efficient Use of Soil Nutrients
- Weeding for Improved Soil Fertility and Efficient Use of Soil Nutrients
- Pesticides Application (handling and applying)
- Planting Shade Trees to Improve Yields and Preserve Soils
- Soil Fertility Management (compost, organic fertilizer)
- Mineral fertilizer application

An Extension Agent training a group of farmers

Farmers trained through direct Extension Agent engagement

*25% Female

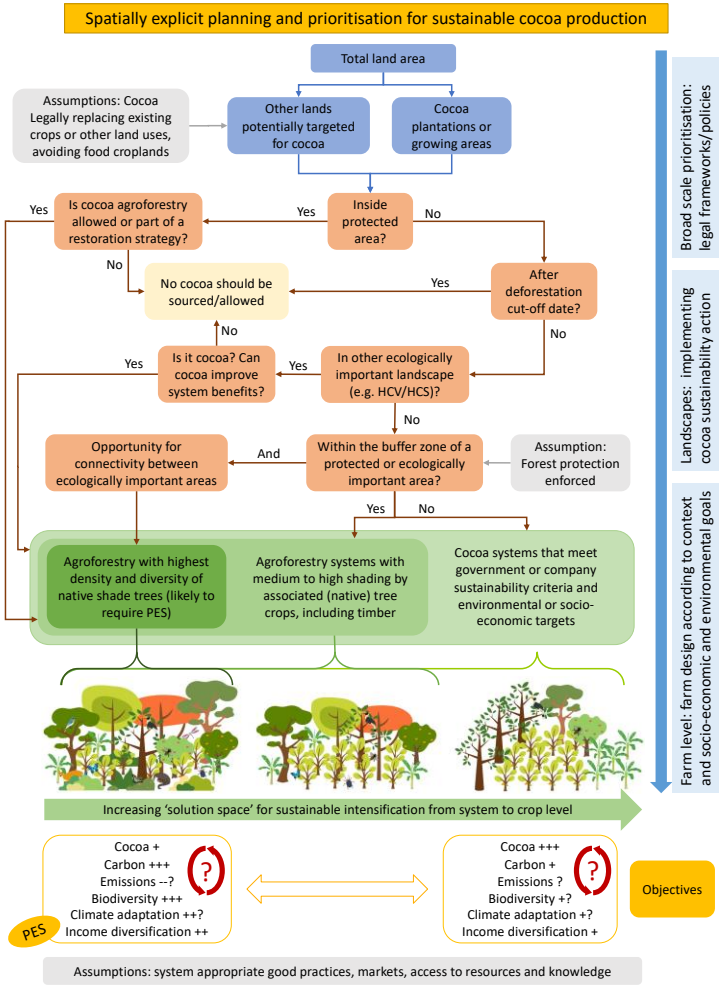
Extension Officer-led training



	Cameroon	Cote d'Ivoire	Ghana	Nigeria	Four Countries
Male	2475	6133	2217	18086	28911
Female	355	442	1114	7899	9810
Total	2830	6575	3331	25985	38721

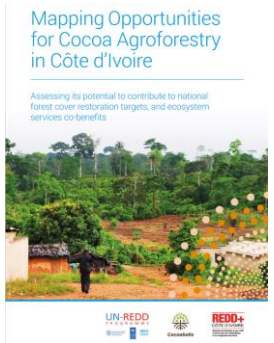
- **30, 782 Farmers trained through digital platforms**
- **Total of 69, 203**

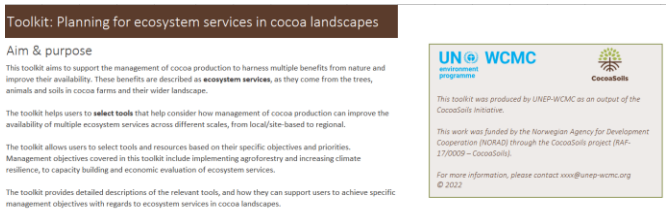
Sustainability assessment tools



- Guidance tree developed to support national/supply chain stakeholders to understand risks and opportunities and plan for sustainable cocoa production. Addressing:
  - deforestation
  - cocoa production
  - biodiversity
  - ecosystem services

  Under climate change
- Elements of this framework addressed through different cases:
  - Spatial analyses: risks and opportunities
  - Modelling studies: understanding impacts
  - Toolkit of tools to support integration of ecosystem services in cocoa planning farm to landscape level

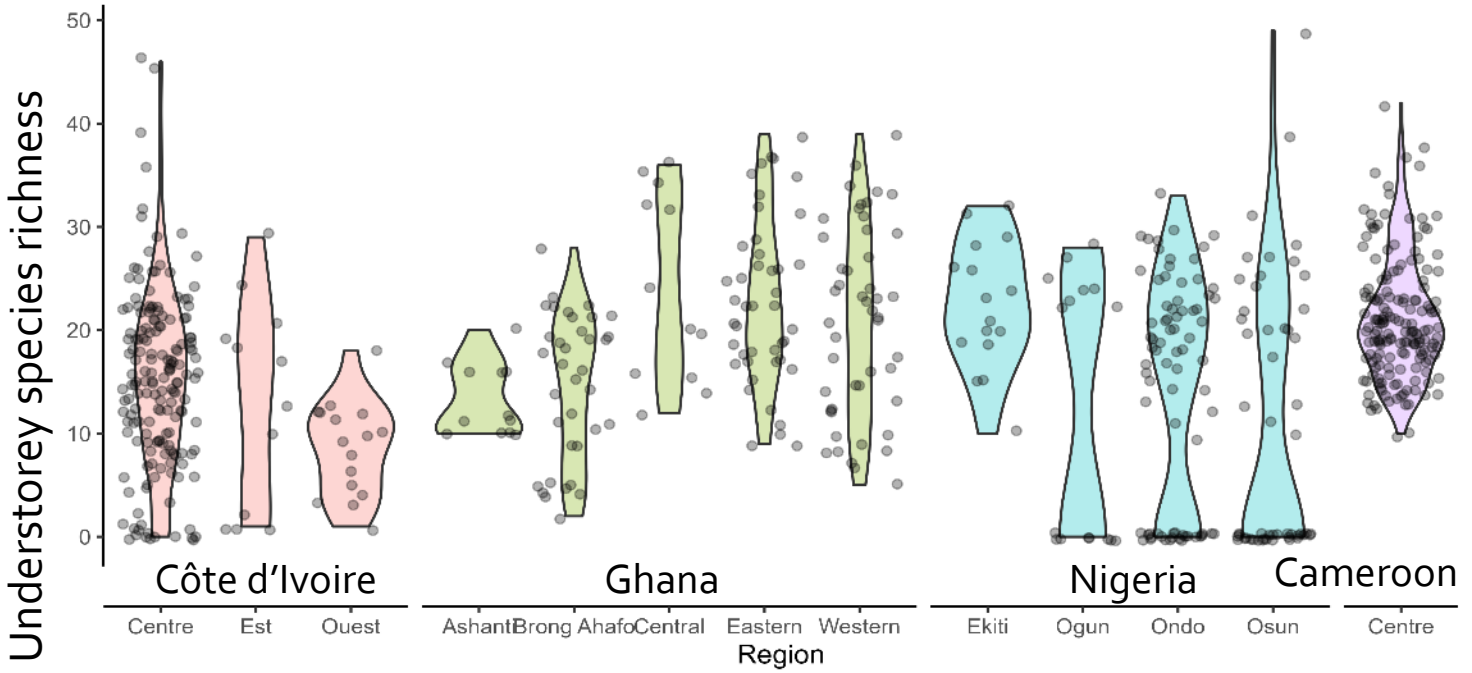


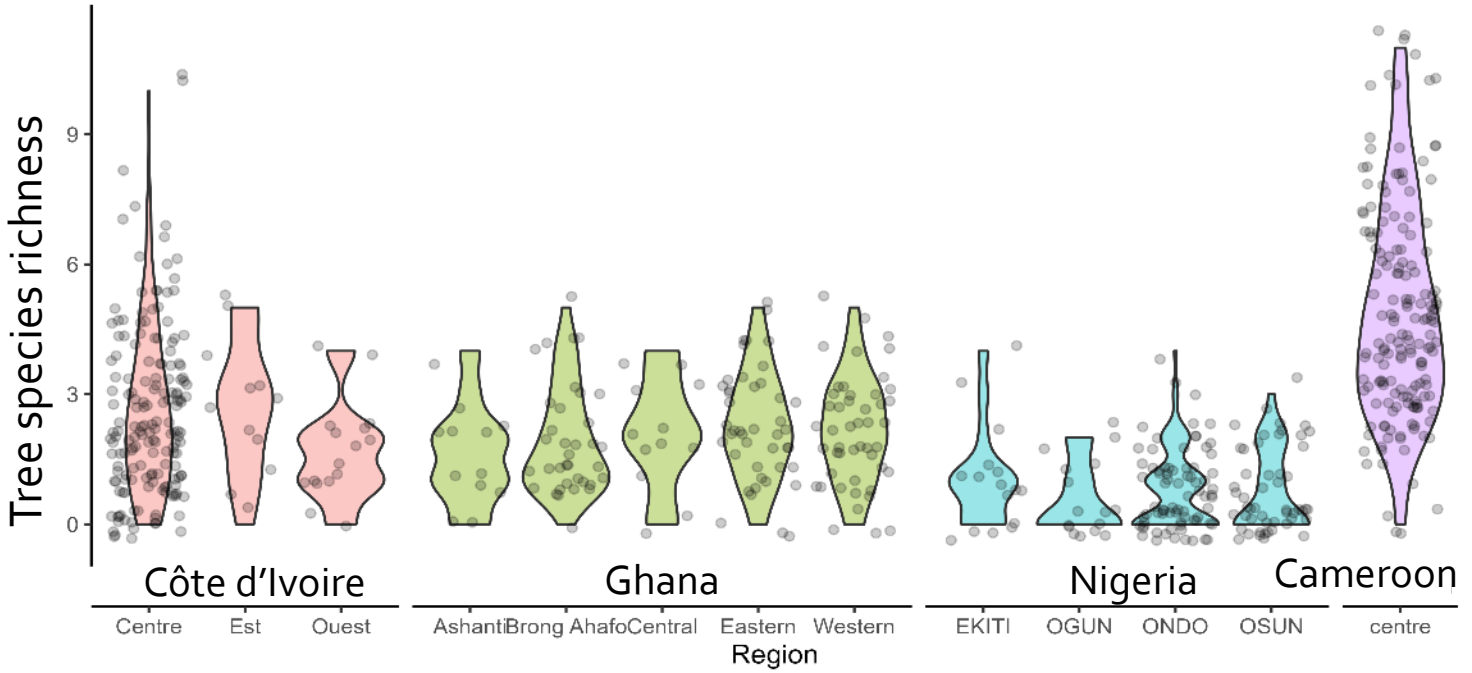


Results: biodiversity patterns

Understorey diversity differed less among countries, though Nigeria had a larger proportion of samples with no understorey plants present.

Tree biodiversity was richest in Cameroon. Côte d'Ivoire and Ghana had intermediate tree richness, with the Central region particularly rich. Nigeria had relatively low tree richness.





Capacity Building - Graduate Students

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- 3 PhDs have graduated from WUR
- Several MSc in the countries

Lucettte will graduate with a PhD in May 2024

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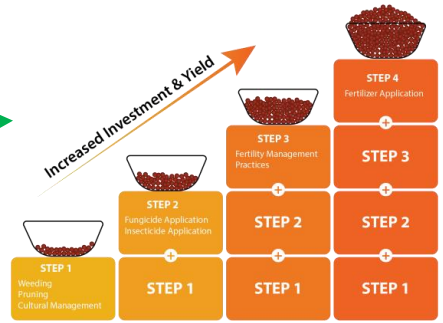
CocoaSoils Moving Forward

Development of decision support - Work in progress

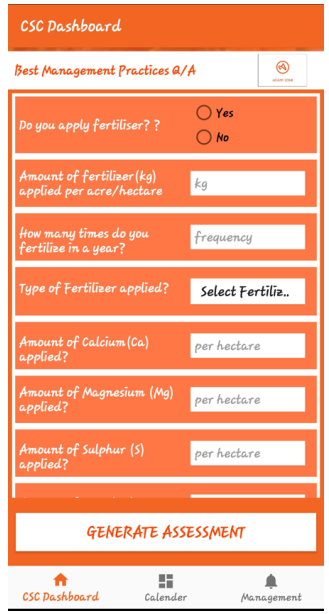
- Prototype with developer/engineer
- Further analytics and validation

Field trials

Analytics:



Advisory apps/ field guides



CocoaSoils Moving Forward

- Core activities
  - Understanding cocoa nutrition and fertilizer requirements
  - Collaborating to improve the yields and income of smallholder farmers
  - Avoiding biodiversity loss – highlighting threats and opportunities
  - Understanding the impacts of climate change
  - Smart irrigation to support ISFM
- New activities
  - Measuring greenhouse gas losses and carbon footprints
  - Tracking soil health
  - Impacts of cocoa nutrition on product quality?
  - ?? Your suggestions??


Thank you!
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visit our website: www.cocoasoils.org