Canopy cover of shade trees improves on-farm cocoa yields in two regions in Ghana

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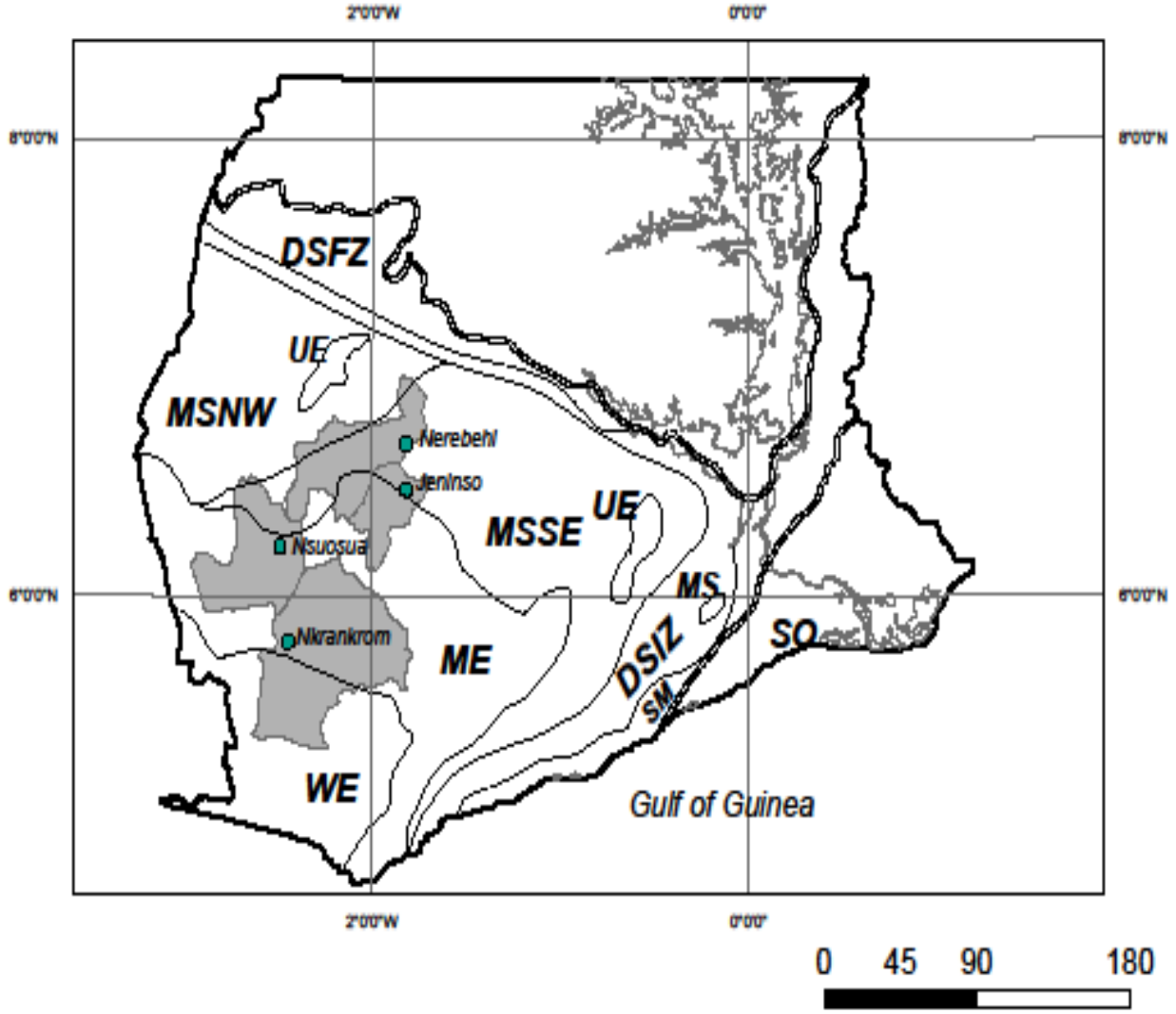
Introduction

- Expansive farming practices and encroachment into forests due to illegal surface mining and human settlements are causing deforestation and land degradation
- Shift from high to low/no shade systems and perception that shade trees have negative impact on cocoa yields
- Ghana is pursuing a low emissions development strategy and is committed to implementing REDD+
- The cocoa sector commits to a strategy that increases on-farm yields while maintaining trees in the landscape
- Synergies between CSA, cocoa and forestry sectors are many

Introduction

- Limited studies that focus on the relationship between canopy cover (shade) and cocoa yield under field conditions
- Increasing shade at plot level resulted in higher cocoa yields
- The complexities between open and shaded plots suggest that studies should be extrapolated to farm scale level
- The objective of this study was to examine the effect of shade on cocoa yields applying a whole-farm perspective, taking into consideration other variables such as management and social factors

Materials and method



- Four communities in Ashanti and Western regions in Ghana
- At least 20 farmers representing the same number of cocoa farms were selected (86)
- Systematic sampling approach that involved focus group discussions and individual interviews
- Repeated cocoa yield measurement for four years:
  - i) farmers' reports on yields
  - ii) yield records from official "Cocoa Passbooks"
  - iii) Farm land measurement with GPS
  - iv) application of fertilizer, insecticide or fungicide in a given year was registered
- Shade cover

$$CA = \pi * (\frac{CD}{2})^2$$

$$CC = \left(\frac{TCA}{Farm\ size}\right)/10000$$

Data analysis

- Cocoa yield was analysed in a linear mixed effect model where Yield, representing annual production of dry cocoa beans per ha was used as the dependent variable
- The study involves repeated measurements within farms and it is necessary to model the correlation between measurements

$$Yield^{1/3} = \alpha(District) + \beta*(Farmsize - \mu_{District}) + \gamma*Cover + \delta(LandUse) + \varepsilon(Training) + \zeta(Fertilizer)$$

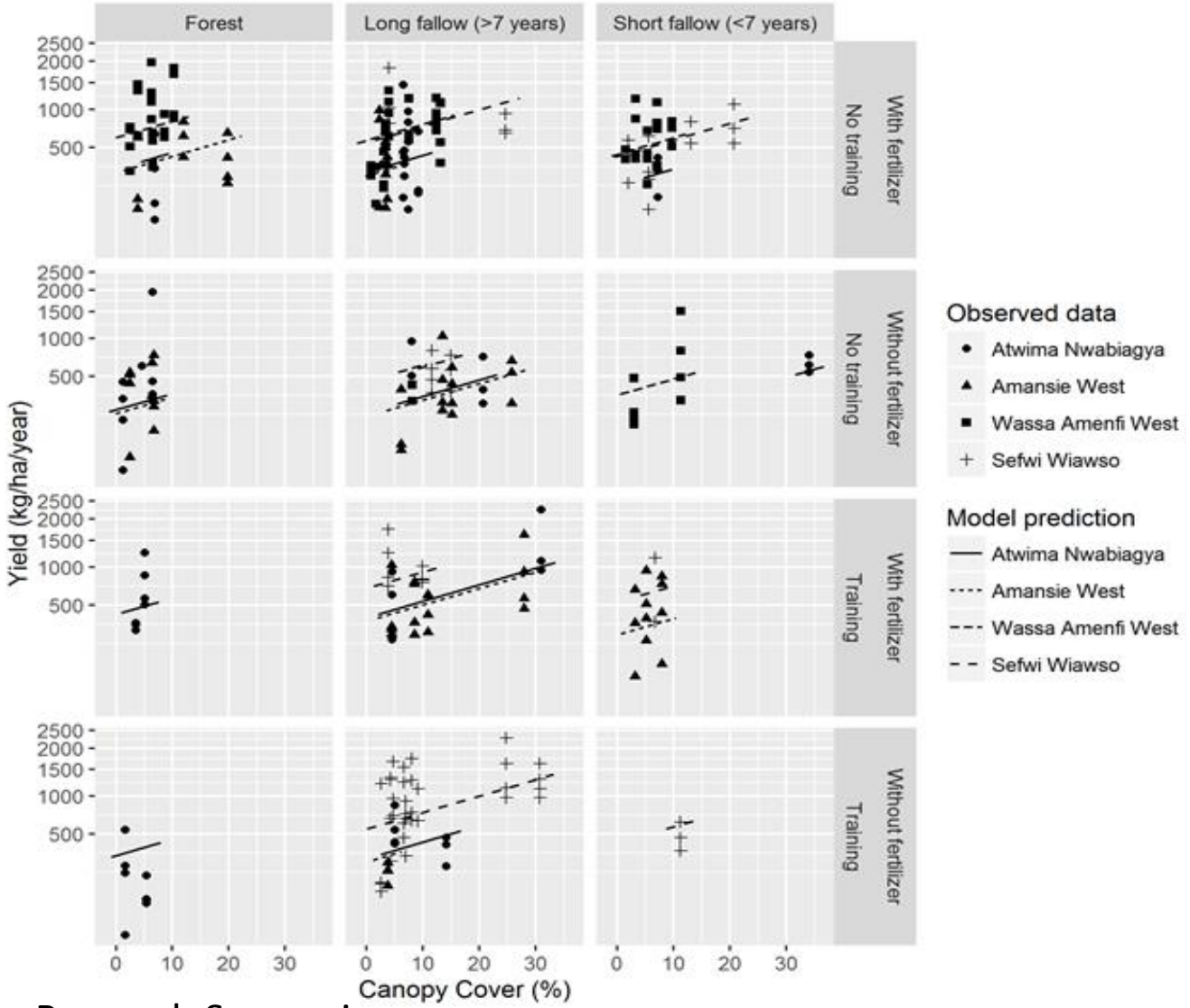
$$+ A(Farm) + B(District, Year) + C(Year) + error$$

- District location of farms (Atwima Nwabiagya, Amansie West, Wassa Amenfi West, Sefwi Wiawso)
- Farmsize (continuous, centralized at the average farm size within districts)
- Canopy Cover of shade trees (continuous)
- Land use type LandUse (forest, long fallow, short fallow)
- Training (no/yes)
- Fertilizer (no/yes)
- 2-way interactions between Cover and Fertilizer, and between District and Training

Results

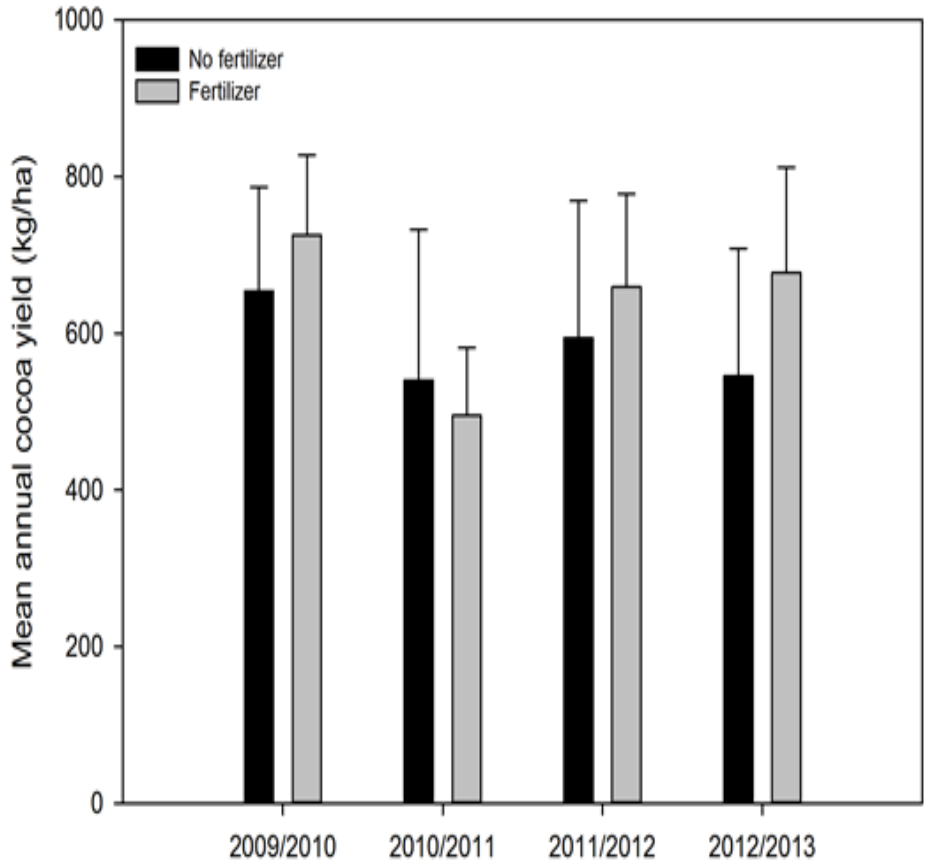
Effect	Parameter	Estimate	95% Confidence interval	P-value
District	α(1)	6.25	5.18; 7.30	0.0048
	α(2)	6.03	5.02; 7.11	
	α(3)	7.91	6.77; 8.98	
	α(4)	7.83	6.73; 9.03	
Farmsize	β	-0.17	-0.34; -0.01	0.0305
Cover	γ	0.07	0.04; 0.11	<0.0001
LandUse	δ(2)-δ(1)	-0.16	-0.69; 0.40	0.0147
	δ(3)-δ(1)	-0.91	-1.60; -0.19	
Training	ε(yes)-ε(no)	0.75	0.18; 1.31	0.0052
Fertilizer	ζ(yes)-ζ(no)	0.64	0.15; 1.13	0.0088

Results cont.

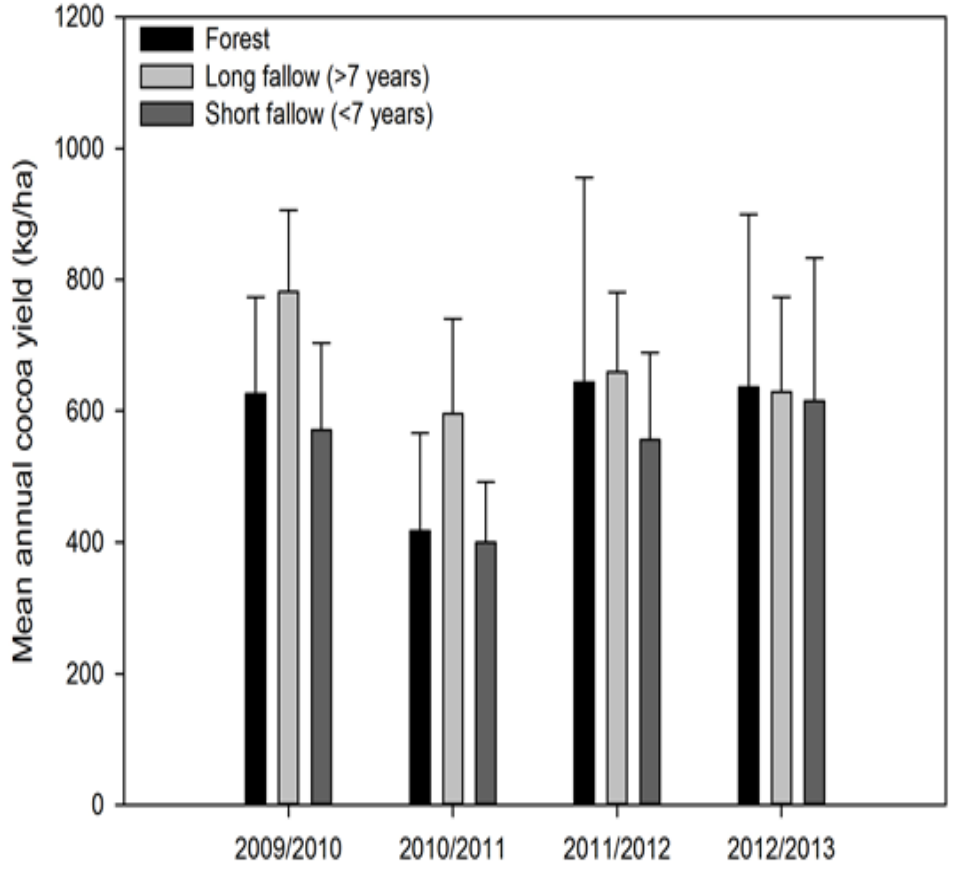


Results cont.

Fertilizer use and cocoa yields



Previous land use and cocoa yields



Conclusions

- For a sustainable, CSC policy there is the need to better understand the relationship between canopy cover and cocoa yield
- This study has shown that shade cover, fertilizers and training have significant positive effects on cocoa yields
- There was a tremendous variation between farms and regions, which to some extent was due to previous land use
- The positive impact of shade cover on cocoa yields alters discussions about trade-offs between productivity and ecosystem services in shaded systems
- Relevant to REDD+ and CSA programs shade trees provides a possible win-win situation in terms of mitigation and adaptation to CC

Perspectives

- We propose that interventions in the cocoa value chain be revisited, and that more focus is given to promotion of shade trees
- Further on-farm research applying multi-year and multi-location approaches with detailed measurement of fertilizer and other agro-chemicals is needed to clarify the role of shade trees in low input systems
- Research could include effects of shade tree species on cocoa productivity, as species are likely to interact differently with cocoa

THANK YOU FOR YOUR ATTENTION