Agricultural intensification for climate change adaptation and mitigation: synergies and tradeoffs

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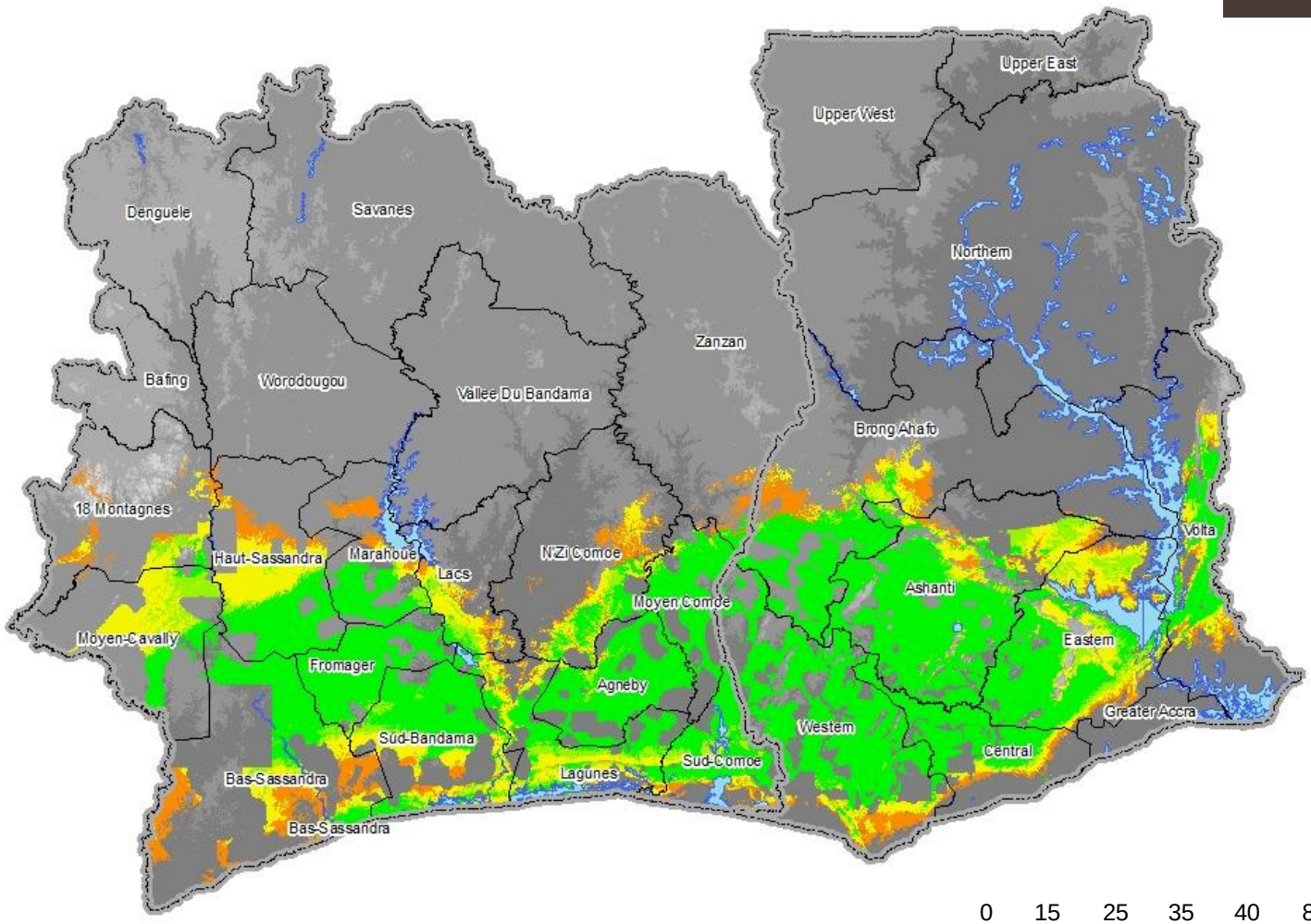
CLIMATE CHANGE AGRICULTURE AND FOOD SECURITY

IITA

CIAT

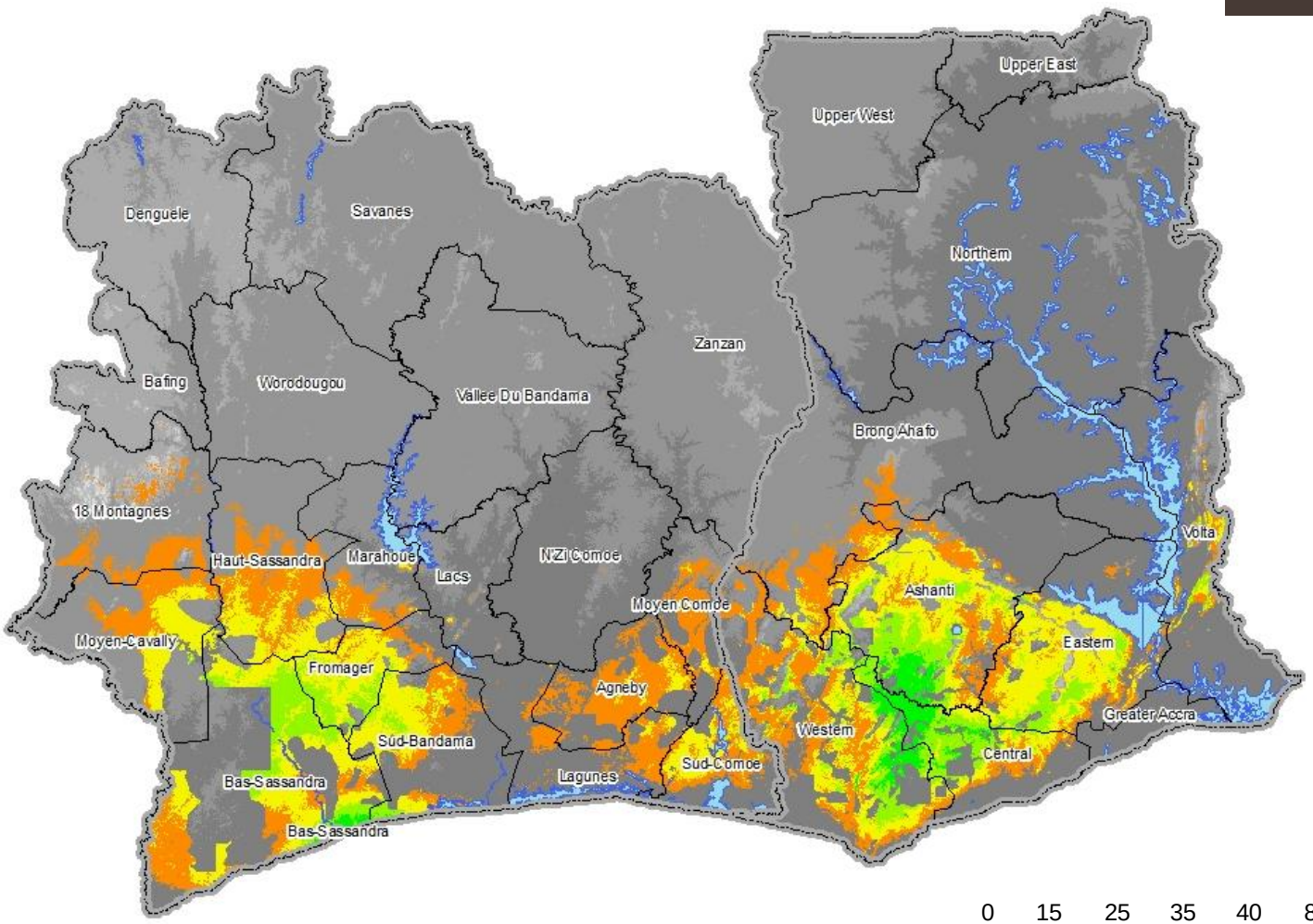
Current Suitability

current



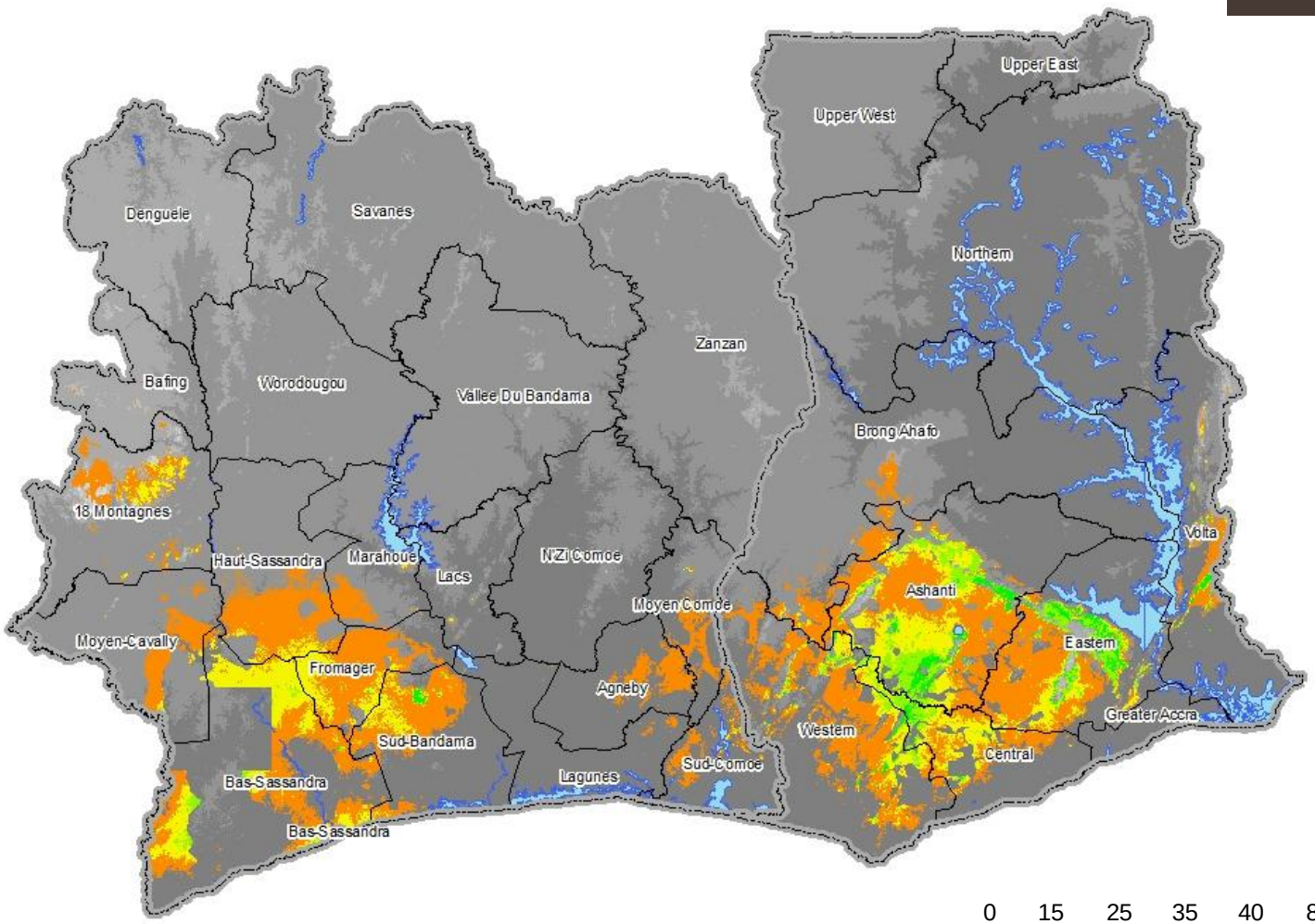
Suitability by 2030

2030



Suitability by 2050

2050



Elevation (masl)

0 200 400 600 800 1000 1200

0 15 25 35 40 85

Barely | Marginal | Good | Very Good | Excellent

PROBLEM STATEMENT – CC ADAPTATION

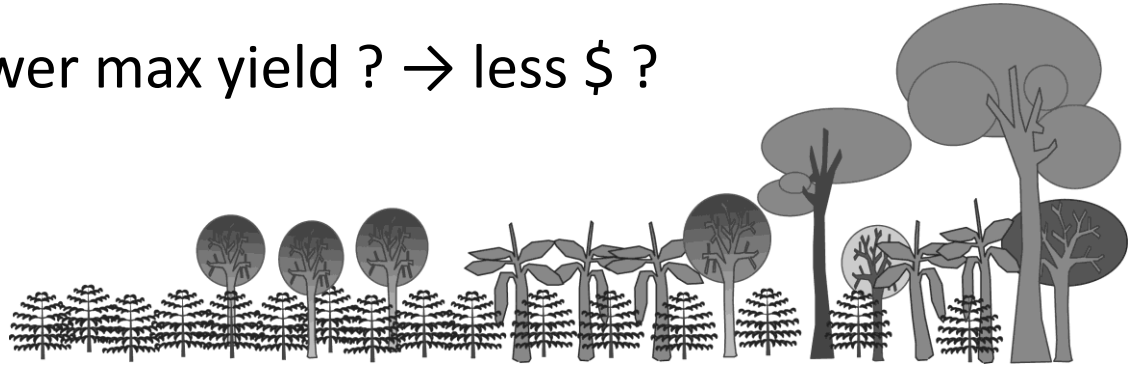
- Adaptation is required – primarily four options
  - Improved drought and pest-resistant varieties
  - Adaptation of micro-climate through shade systems
  - Irrigation systems
  - Switch to other crops

- This requires investment!
  - Smallholder farmers may not invest in long-term solutions if these do not generate short term returns on investment

Unshaded coffee tress decimated by drought

SYNERGIES AND TRADE-OFFS AT PLOT LEVEL

- Shaded systems: adaptation and mitigation synergies
- Adoption constraint: short term returns on investment
- Shade → lower max yield ? → less $?



Plot level functions	Full sun monocrop	Shade tree monocrop	Banana / food intercrop	Polyculture system	Forest system
Yield quantity					
Yield quality					
External input use					
Nutrient recycling					
Production risks					
Plantation life					
Food security					
CC adaptation					
Carbon stock					
Ecological services					

light color = low → dark color = high

MITIGATION IN COFFEE

- Markets increasingly focus on carbon footprint
  - Price incentives for farmers to plant/maintain trees in agric fields
  - GHG attribution along the value chain is a challenge (LCA)
  - Trade-offs at landscape and global level are less obvious

- Retailers

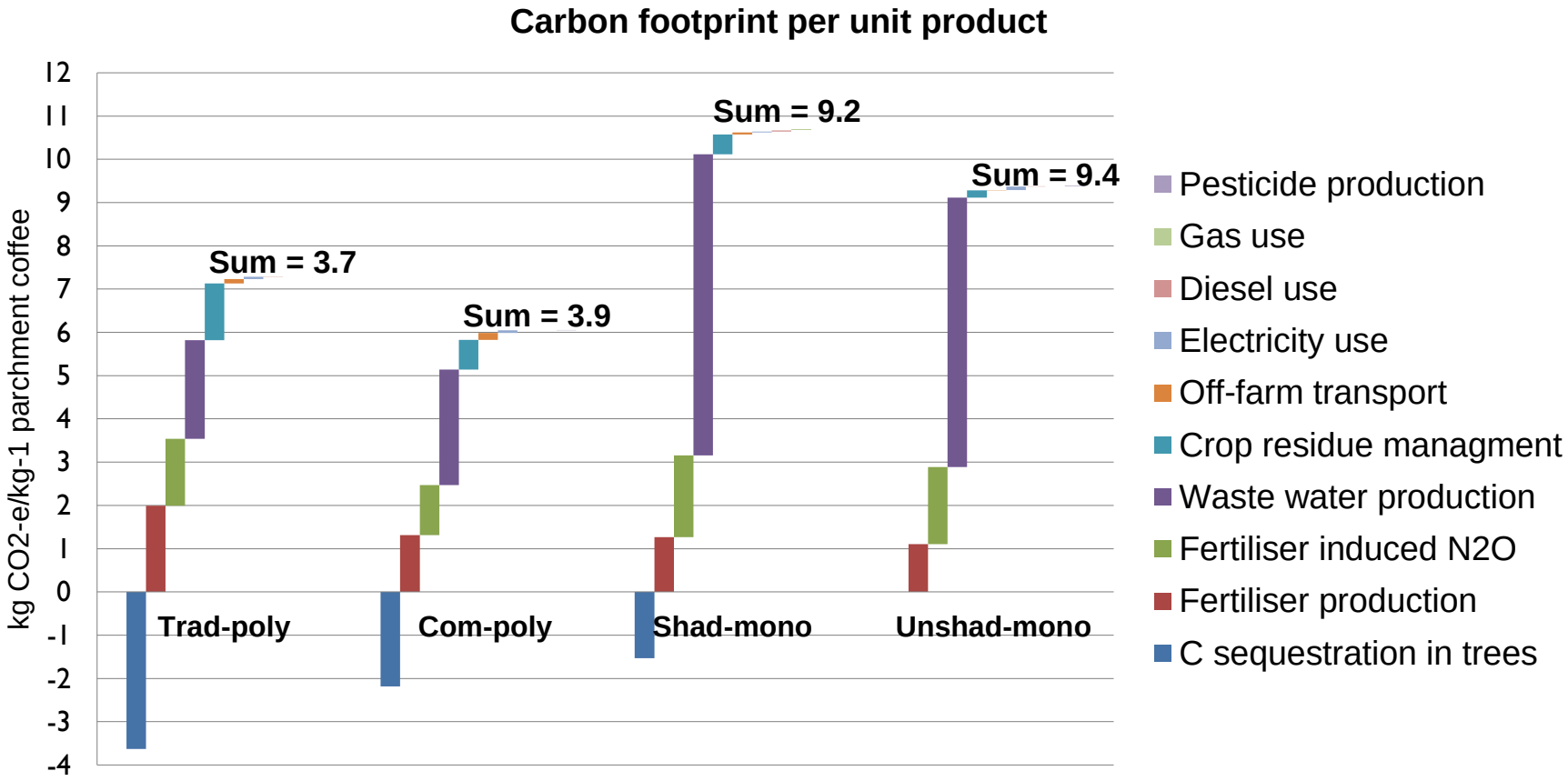
Rainforest Alliance

ISEAL ALLIANCE

4C ASSOCIATION
for a better coffee world

- Certification bodies

CARBON FOOTPRINT – example LA



- Carbon footprint of intensive systems 2-3 times higher, but primarily caused by differences in post-harvest processing.

TRADE-OFFS AT LANDSCAPE/GLOBAL SCALE

Agriculture is major driver of deforestation and GHG emission

→ low yields requires more area (Burney et al, 2010)

→ clearing for small-scale agriculture is the greatest cause of African deforestation (IUFRO, 2010)

→ cocoa intensification could have reduced deforestation by 21k ha in West Africa (Gockowski & Sonwa, 2010)

→ better land sparing than land sharing for biodiversity (Ben Phanal et al, 2011)

Toward a whole-landscape approach for sustainable land use in the tropics →

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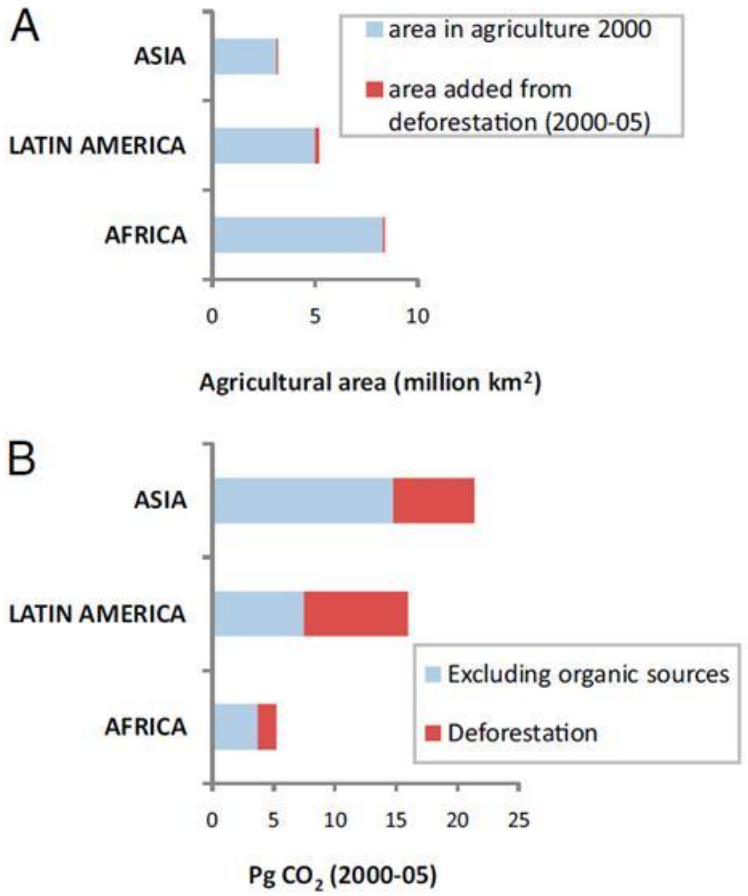
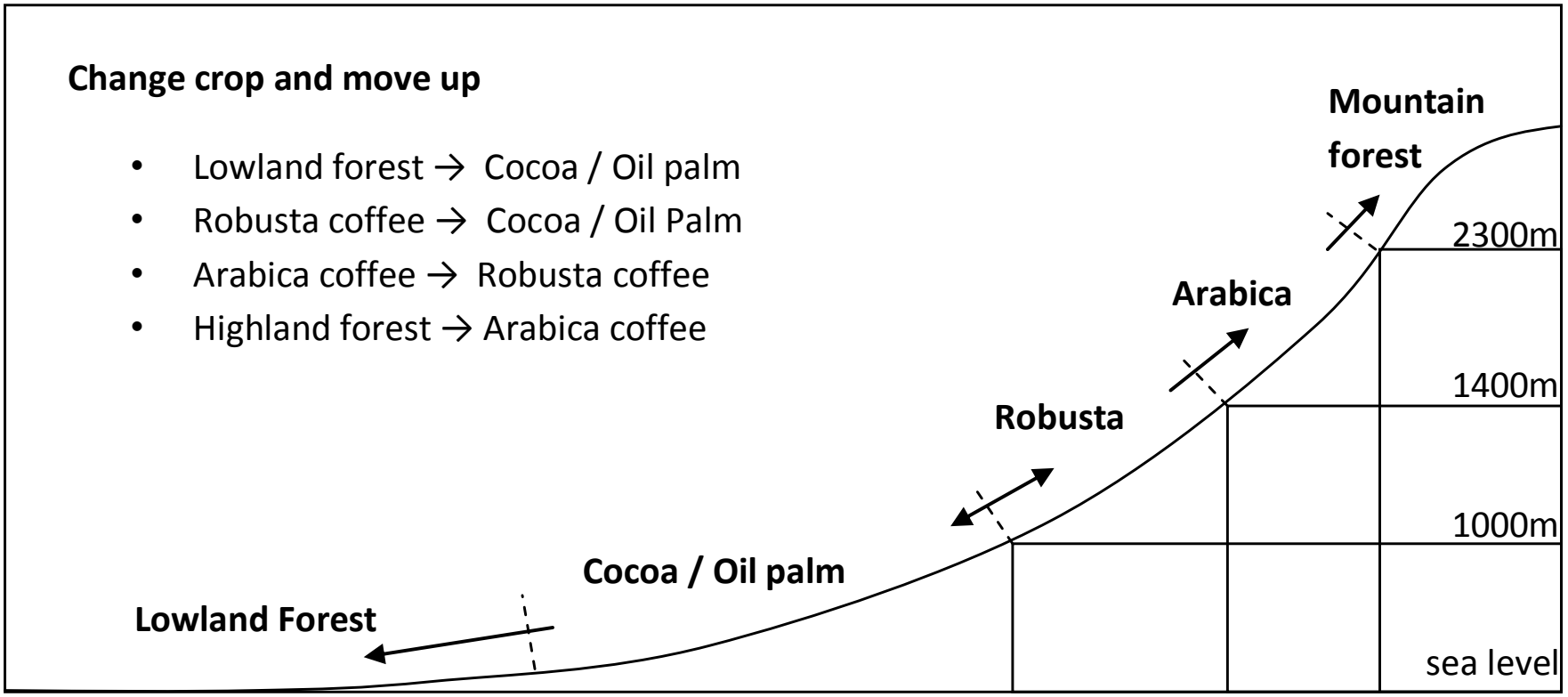
Increasing food production and mitigating climate change are two primary but seemingly contradictory objectives for tropical landscapes. This special feature examines synergies and trade-offs among these objectives. Four themes emerge from the papers: the important roles of both forest and agriculture sectors for climate mitigation in tropical countries; the minor contribution from deforestation-related agricultural expansion to overall food production at global and continental scales; the opportunities for synergies between improved food production and reductions in greenhouse gas emissions through diversion of agricultural expansion to already-cleared lands, improved soil, crop, and livestock management, and agroforestry; and the need for targeted policy and management interventions to make these synergistic opportunities a reality. We conclude that agricultural intensification is a key factor to meet dual objectives of food production and climate mitigation, but there is no single panacea for balancing these objectives in all tropical landscapes. Place-specific strategies for sustainable land use emerge from assessments of current land use, demographics, and other biophysical and socioeconomic characteristics, using a whole-landscape, multisector perspective.



THE TRADE-OFFS AT LANDSCAPE/GLOBAL SCALE

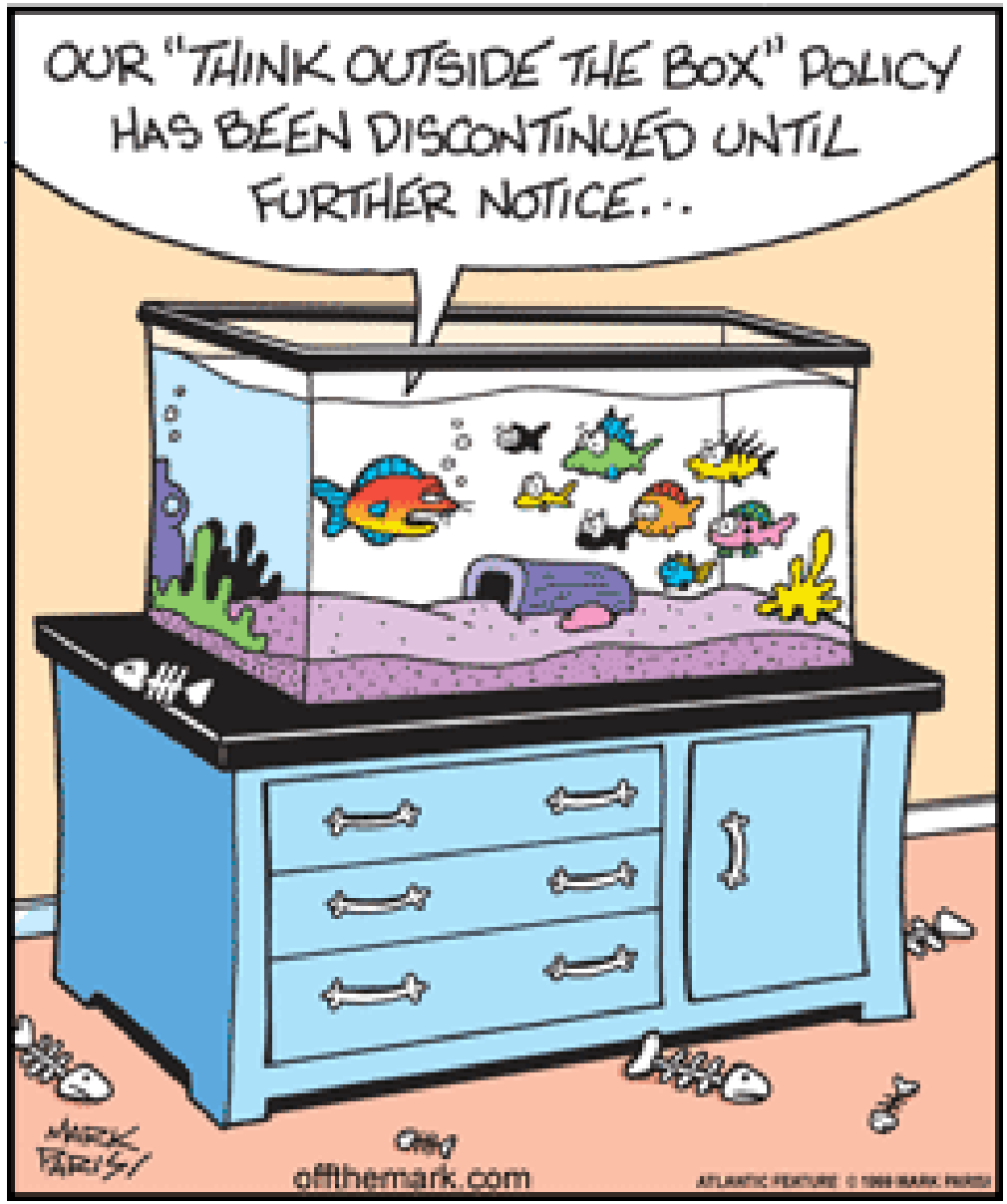
Coffee and cocoa area should not expand or shift to preserve forests?



Possible changes in land use and crops induced by climate change

CHALLENGES

- Research
  - Quantify carbon costs along value chain
  - Attributing carbon ‘opportunity costs’ when not intensifying
  - Balance smallholder needs at plot level (e.g. low risk, low dependency on external input, high sustainability) with ecological aims at global level (e.g. forest conservation).
  - Find adaptation practices that yield short term returns to investment but decrease climate change vulnerability in the long term
  - Develop tools for trade-off modelling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Locations of agribusiness clusters (approx.)