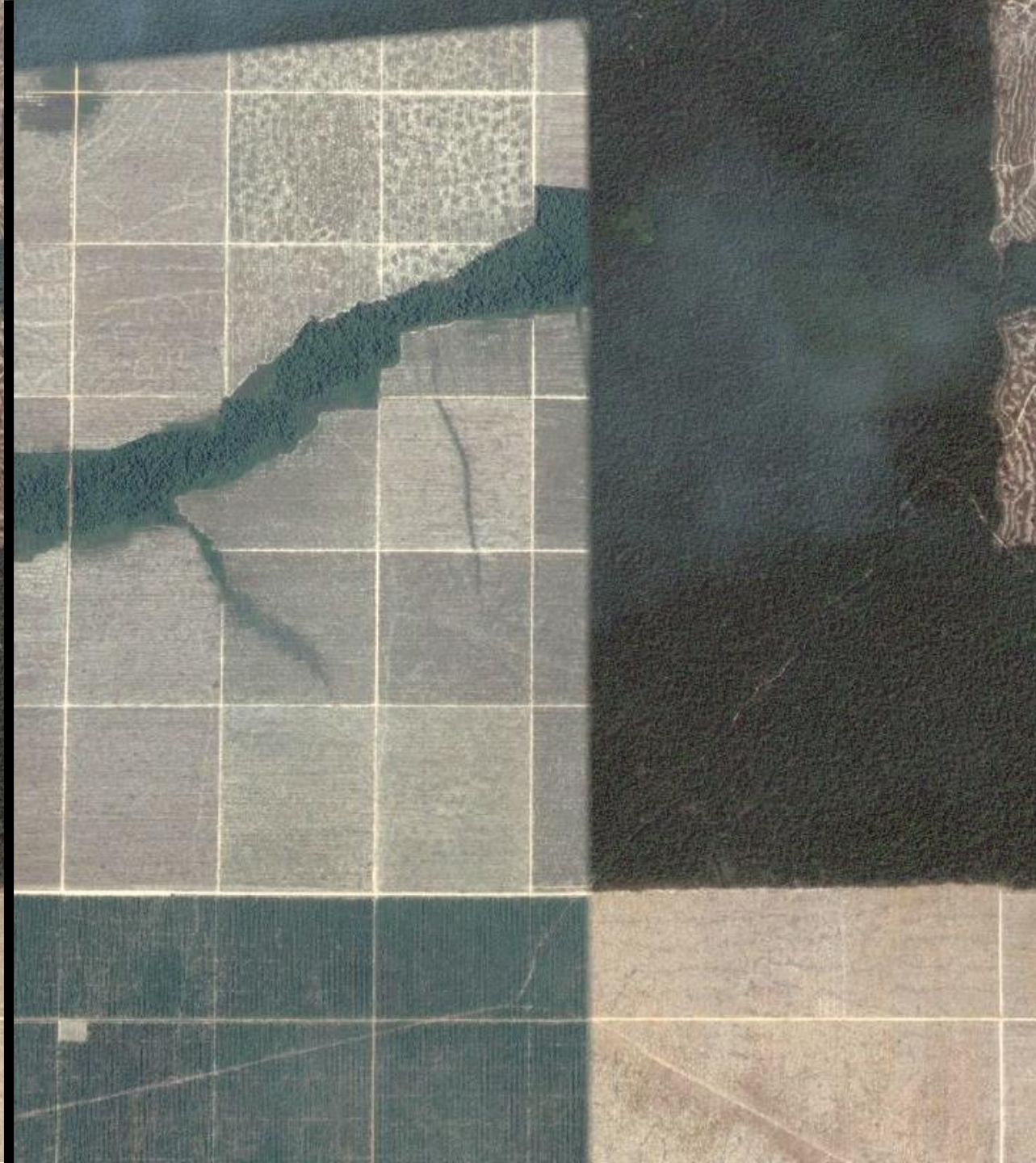
Protecting tropical forests from the rapid expansion of rubber using carbon payments



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REVIEWS

Increasing Demand for Natural Rubber Necessitates a Robust Sustainability Initiative to Mitigate Impacts on Tropical Biodiversity

Eleanor Warren-Thomas[1], Paul M. Dolman[1], & David P. Edwards[2]

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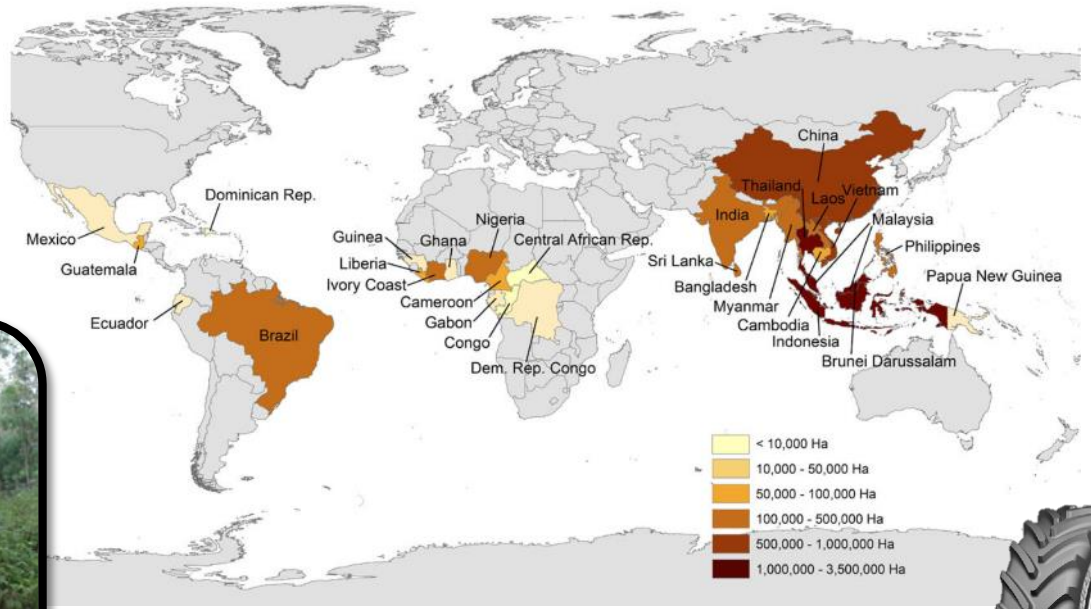

- Synthetic rubber (50%) cannot completely replace natural rubber
- 70% consumption for tyres
- High-yielding *Hevea brasiliensis*
- Trees manually tapped for latex
- 84% in Southeast Asia
  30% Thailand
  27% Indonesia

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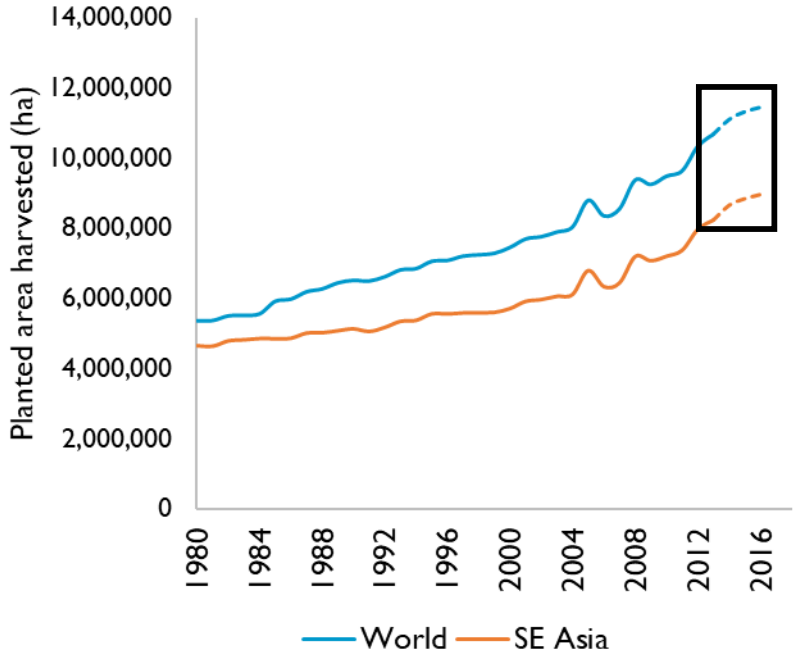

2010 (baseline)
10.7 million tonnes / 9.4 million ha

2018 (projection)

Industry (IRSG) prediction:
13.0 million tonnes

We calculated this would require:
1.4 – 3.9 million ha expansion

Latest data:

Global rubber area expanded by 2 million ha 2010 → 2016
(FAO 2017)

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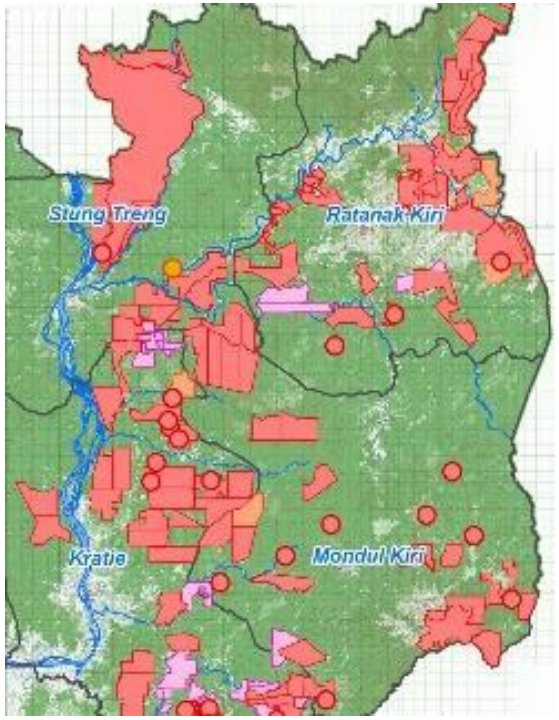
What's the problem with expanding rubber plantations?



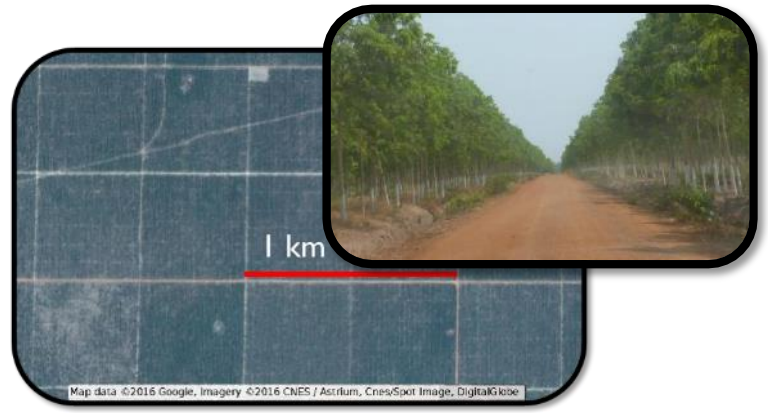
Open Development Cambodia: Economic Land Concessions and forest cover

Thailand
Indonesia
China
Myanmar

→ Smallholder monoculture/ agroforest

Vietnam
<u>Cambodia</u>
Laos
West Africa?

→ <u>Industrial monoculture</u>



Expansion onto forest → deforestation → biodiversity loss and carbon emissions

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Forest protection incentives: carbon finance (REDD+)

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ARTICLE

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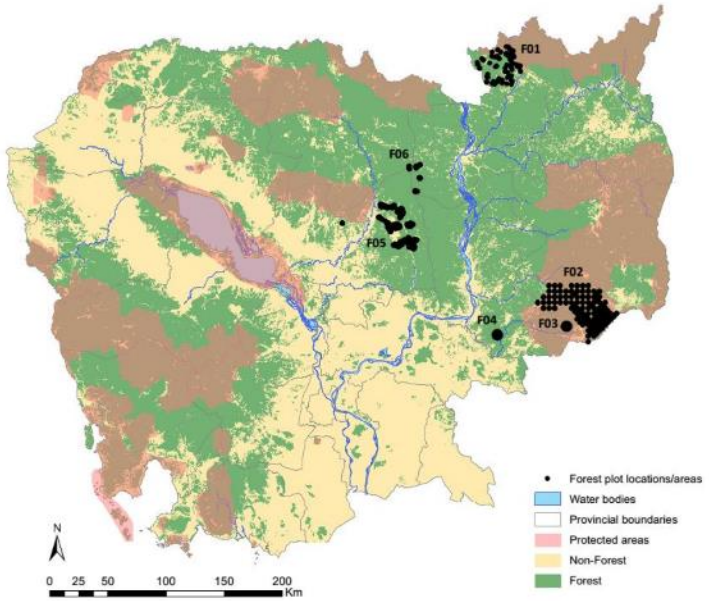
Protecting tropical forests from the rapid expansion of rubber using carbon payments

Eleanor M. Warren-Thomas[1,2], David P. Edwards[3], Daniel P. Bebber[4], Phourin Chhang[5], Alex N. Diment[6], Tom D. Evans[7], Frances H. Lambrick[8], James F. Maxwell[9], Menghor Nut[10], Hannah J. O'Kelly[6], Ida Theilade[9] & Paul M. Dolman[1]



Cambodia

Payments for avoided carbon emissions could be an incentive to conserve forest

Efficacy of payments likely to be limited unless carbon prices ($ per tCO_2) match, or at least approach:

opportunity costs ($ ha^{-1}) i.e. timber & profits from rubber cultivation

& setup and implementation costs ($ ha^{-1}) e.g. verification, validation, law enforcement, alternative livelihoods

Research question:
What breakeven carbon price is needed to match the costs of forest protection, where demand for land is driven by rubber plantation expansion?
(a cost-benefit analysis)

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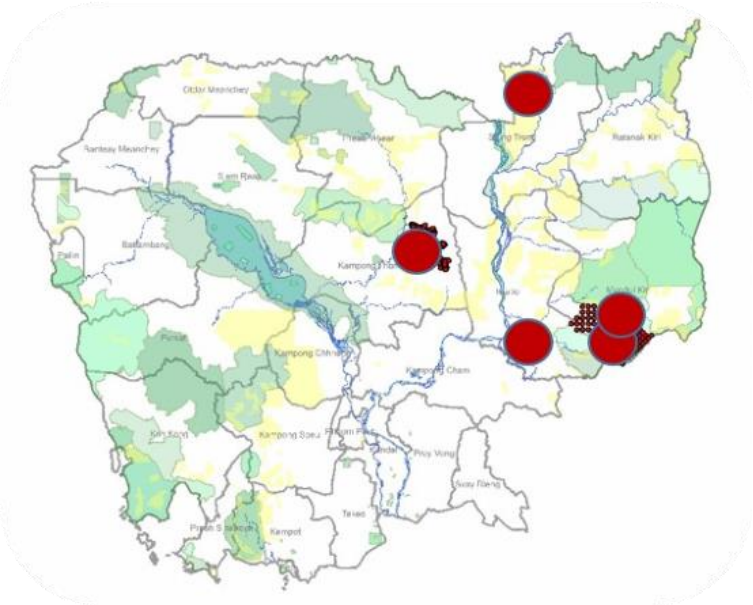
Calculating breakeven carbon prices for forest protection from rubber in Cambodia

Breakeven carbon price US per $ tCO_2 =

$$\frac{\text{timber \$ + rubber \$ + setup \$ + implementation \$}}{3.67 * \text{tC ha}^{-1}}$$

>9,000 trees; 525 plots

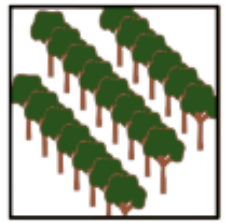


No timber logged

Luxury timber logged

Luxury, I + II timber logged

All timber logged



+ rubber

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Calculating breakeven carbon prices for forest protection from rubber in Cambodia

Modelling approach - sampling 10,000 times from data distributions of:

- timber volume (by timber class)
- timber prices (per class)
- logging costs
- forest carbon stock (linked to timber volume)
- post-deforestation land use carbon stock
- dipterocarp resin (NTFP)
- rubber farm-gate price
- rubber yields
- rubber production costs

Net present value calculation for rubber

Discounting future values to the present day
25 year time frame
5%, 8%, **10%** and 15% discount rates

(also applied to sugar, cassava and cashew for comparison)

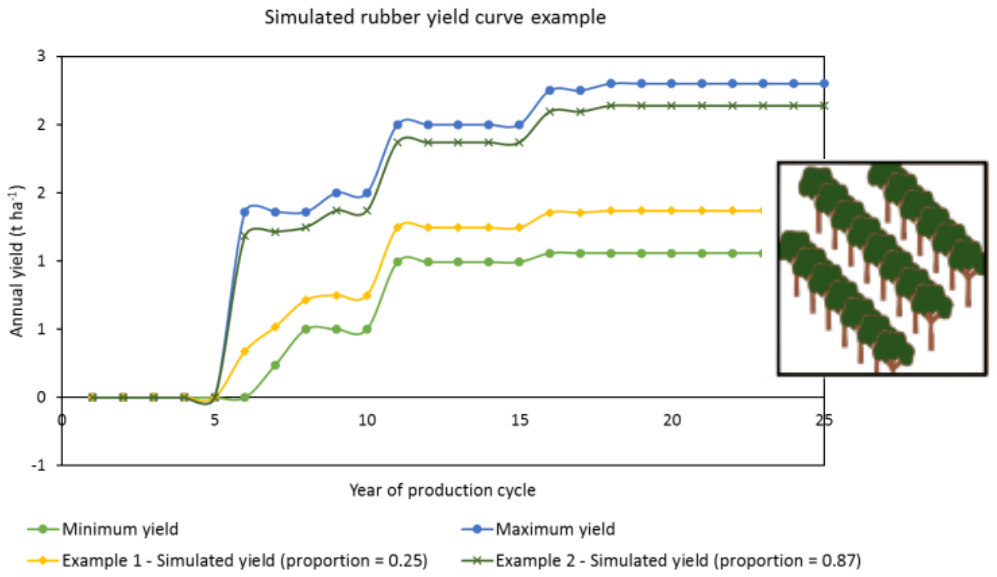

Table 1 Mean carbon stock and wood volume held in harvestable stems of each timber royalty class in dense and open forests

Forest type	Timber royalty class	Carbon stock ≥40 cm DBH (tC per ha)	Carbon stock ≥30 cm DBH (tC per ha)	Wood volume ≥40 cm DBH (m^3 per ha)	Wood volume ≥30 cm DBH (m^3 per ha)
Dense	Luxury	2.2 ± 0.0		1.1 ± 0.3	
	I	30.8 ± 0.4	35.0 ± 0.4	16.9 ± 0.2	19.2 ± 0.3
	II	12.1 ± 0.3	14.6 ± 0.3	9.8 ± 0.2	12.1 ± 0.2
	III	3.5 ± 0.1	5.3 ± 0.1	2.4 ± 0.1	3.4 ± 0.1
	Non-classified	39.0 ± 0.4	53.5 ± 0.5	19.3 ± 0.2	26.2 ± 0.2
Open	Luxury	1.8 ± 0.1		1.3 ± 0.1	
	I	20.5 ± 0.5	29.5 ± 0.1	6.6 ± 0.1	14.7 ± 0.3
	II	4.6 ± 0.1	9.1 ± 0.0	2.7 ± 0.1	7.0 ± 0.1
	III	0.5 ± 0.0	1.2 ± 0.4	0.3 ± 0.0	1.5 ± 0.0
	Non-classified	8.0 ± 0.3	12.6 ± 0.1	2.7 ± 0.1	8.0 ± 0.2

Mean carbon stock and wood volume are shown with the 95% confidence interval of the mean

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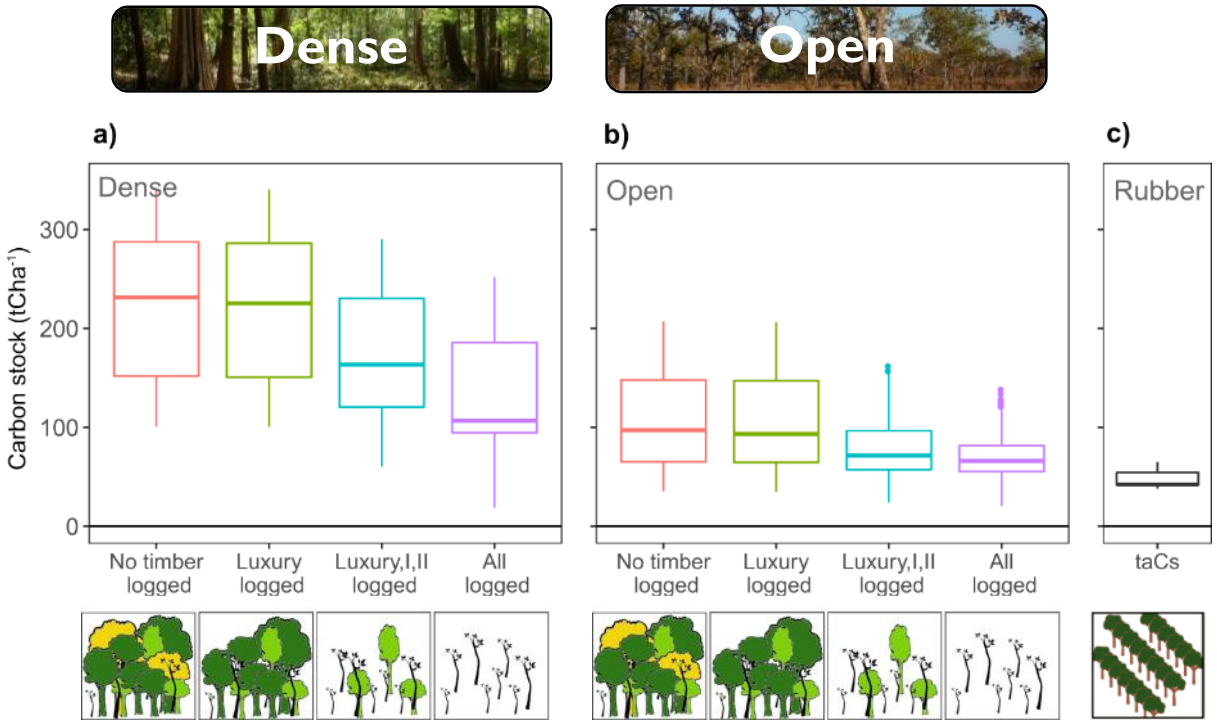
Results:
carbon emission outcomes of converting forests to rubber



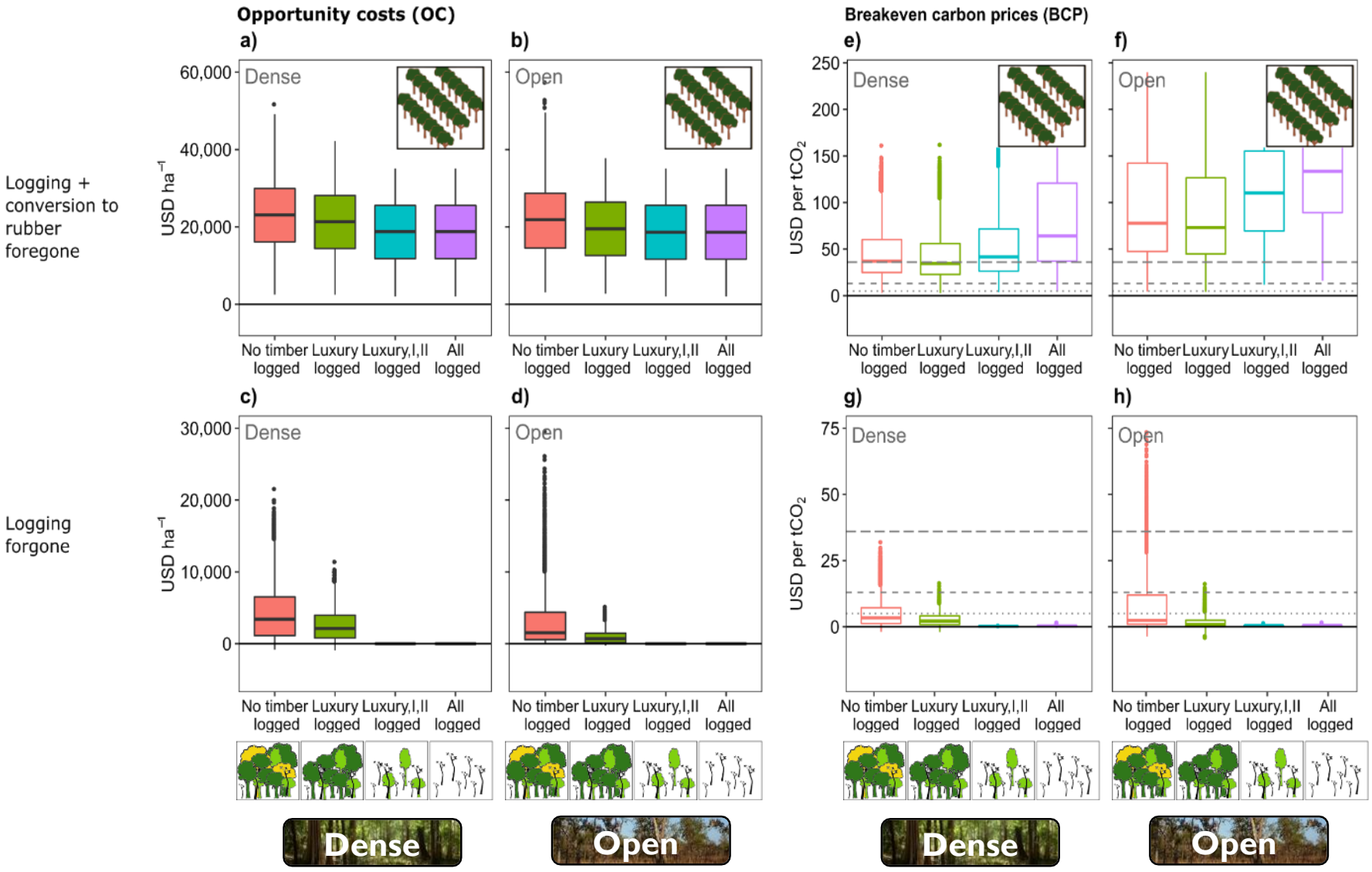
(AGB + BGB)

- substantial forest carbon is retained before conversion to rubber, even after logging of valuable timber or removing all large trees

- forest conversion to rubber generates net emissions of
  141.5 ± 1.2 tC per ha in dense forest
  51.5 ± 0.8 tC per ha in open forest

  (even after logging)

Results: opportunity costs and carbon prices



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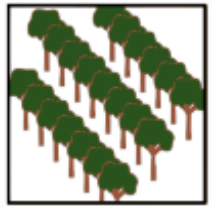
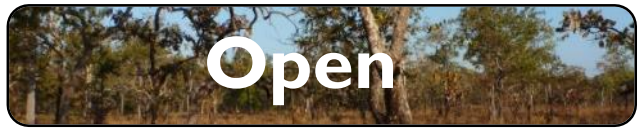
Results: opportunity costs and carbon prices

+



$3,443 ha^{-1}
$4.27 per tCO$_2$

$16,841 ha^{-1}
$33.43 per tCO$_2$



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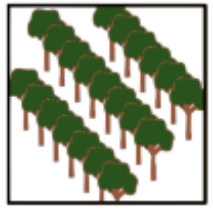

$1,534 ha^{-1}
$2.43 per tCO$_2$

$7,674 ha^{-1}
$51.11 per tCO$_2$

Rubber forms the majority of total opportunity costs:
- 75% in dense forest
- 66% in open forest)

Breakeven prices (per tCO$_2$) far higher than carbon market or fund prices ($5 – 13)
- $33 in dense
- $51 in open

Logging has little effect

Cassava and cashew results similar

Market prices ~$5 | Compliance prices ~$13 | Social cost ~$36 - $100?

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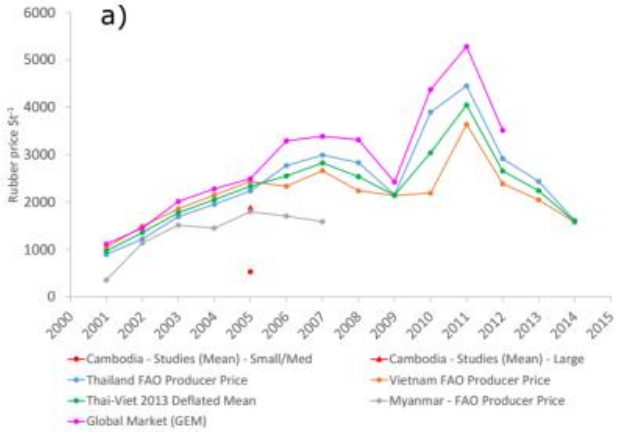
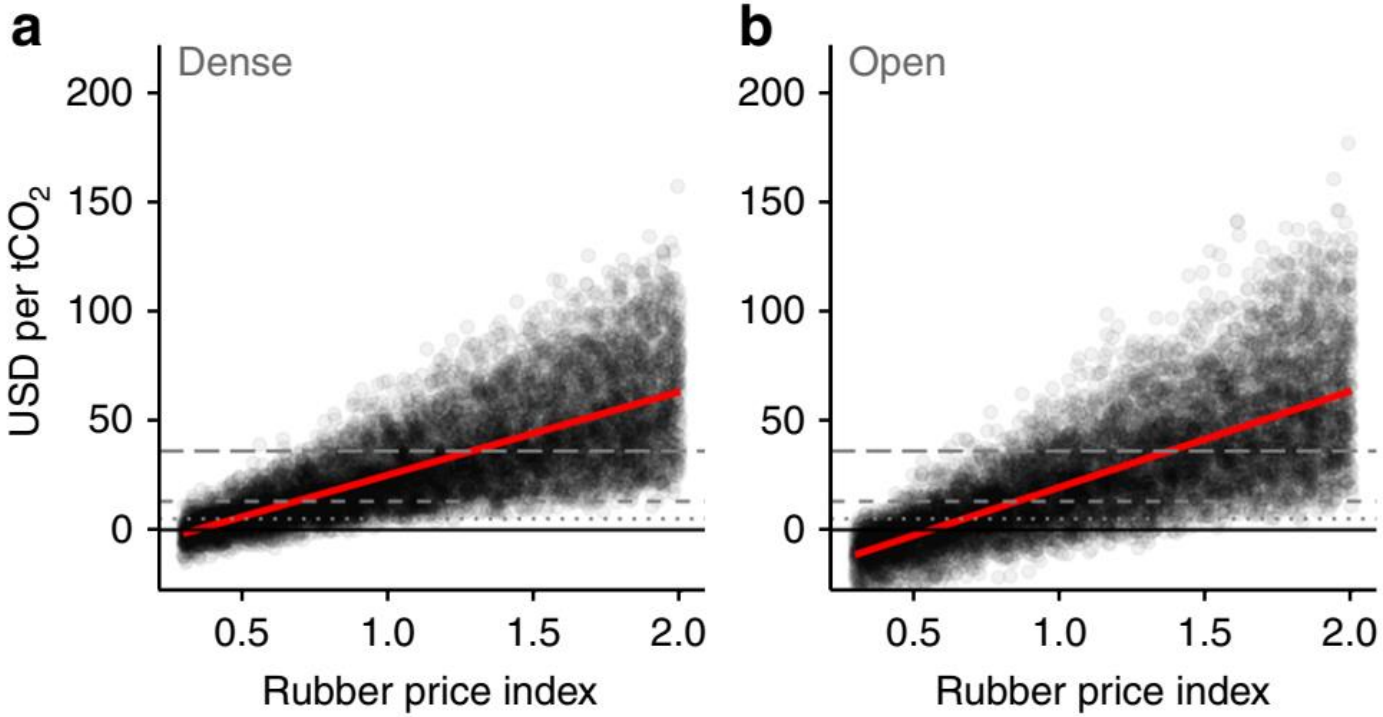
Results: impact of rubber price



- Rubber prices variable – used the 10-year mean price ($2,595 ± 200 per t)
- Breakeven prices remain high even at the 2014 price ($1,644 ± 200 per t)
  - $19.09 in dense forest
  - $16.08 in open



Intact forest scenario
Grey dashed lines indicate real-world carbon prices.
Index value of 1.0 is the 10-year mean rubber price (2003–2012)

What hope for forest protection using REDD+ in the face of rubber expansion?

- Current carbon prices ($5 per tCO^2) could compensate logging opportunity costs, but not rubber (or cassava, cashew)
- enforcement of forest protection or market exclusion of "deforestation rubber" via sustainability initiatives/zero deforestation pledges could help
- avoiding deforestation requires recognition of non-market forest benefits + a willingness to accept apparent economic costs
- **BUT breakeven prices were closely aligned to estimates of the social cost of carbon - forest conversion to rubber is poor option from a global perspective**
  → need to raise carbon prices
- Ultimately, the demand for natural rubber might only be mitigated through improvements in methods for recycling natural rubber
- Single-crop sustainability initiatives may have unintended consequences → need holistic solutions

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Thanks!

Co-authors:
David Edwards, Daniel Bebber, Phourin Chhang, Alex Diment, Tom Evans, Fran Lambrick, James Maxwell, Menghor Nut, Hannah O'Kelly, Ida Theilade, Oskar Brattstrom, Sara Bumrungsri, Watinee Juthong, Luke Nelson, **Paul Dolman**

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