Environmental Income, Poverty, and Climate Change

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Sven Wunder, Frederik Noack, Therese Dokken, Arild Angelsen, Jan Börner

CGIAR CIFOR

Poverty & Environment Network (PEN)

- Pan-tropical/ subtropical data sample
- Quarterly household income; household + village context data
- Focus: count forest & environmental income contributions – grossly under-represented in LSMS + other national surveys
- Uniform questionnaire tools (inspired by Cavendish 2000)
- Mainly PhD student partners
- CIFOR coordinated, but highly collaborative

PEN field sites

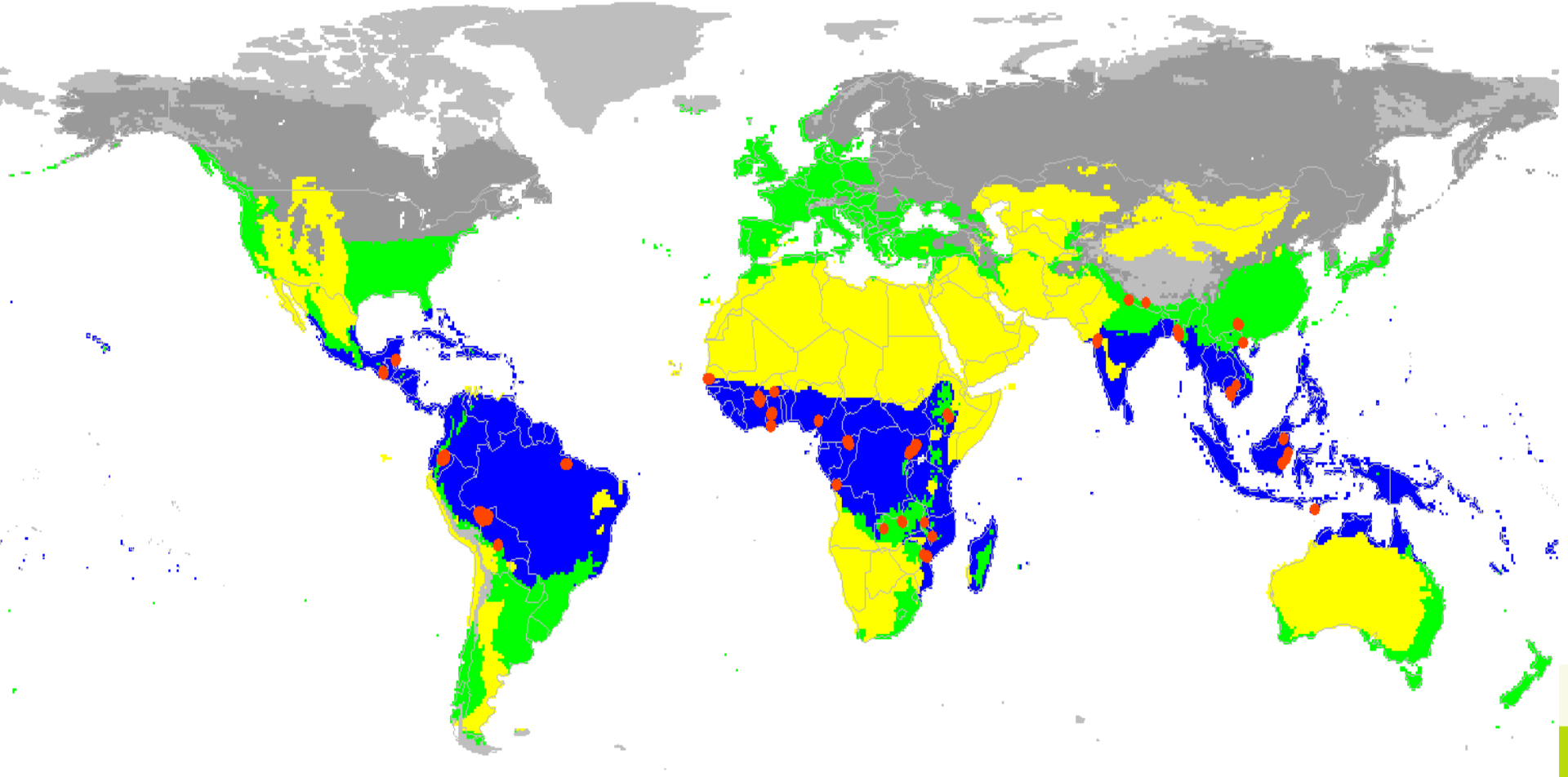
24 countries, 33 partners, 58 sites, 360 villages, 8,000+ households. Data collected 2006–2010

PEN sites & Köppen-Geiger zones

Tropical zones

Subtropical/ temperate

Dry zones



PEN's multilayered sampling strategy

- Our criteria for (non-random) **site** selection:
  - Within a tropical or sub-tropical developing region,
  - *Some* access to forests (0 < forest cover < 100%)
- Site selection was opportunistic (PhD student choice) – with some posterior gap-filling (e.g. West Africa)
- Within sites: stratified **village** selection (pre-defined gradients), random **household** selection in villages

=> Broadly representative of smallholder-dominated tropical and sub-tropical landscapes with moderate-to-good access to forests; all but highest pop density.

=> Slight bias toward areas with "good forests" (vis-a-vis "rural developing world" baseline), and Africa

Research questions on climate-income linkages

RQ1: How much do the rural poor depend on environmental incomes, and how do these determine their current vulnerability and their capacity to adapt to climate change? (*static cross-section)*

RQ2: How could climate change affect the vulnerability of the rural poor in the future through impacts on environmental and other incomes? (*predictive-speculative)*
[analysis not yet finished]

Linking income and asset poverty: structurally vs. stochastically poor

- Classification of poverty type limited by lack of panel data
- Using hh assets to predict income (Dokken & Angelsen, 2015): Predictors**: hh assets** + hh & village **contextual** variables (by region)

		Predicted income	
		Low	High
Observed income	Low	**Structurally poor**	**Stochastically poor**
	High	**Stochastically non-poor**	**Structurally non-poor**

Environmental reliance across structural poverty categories

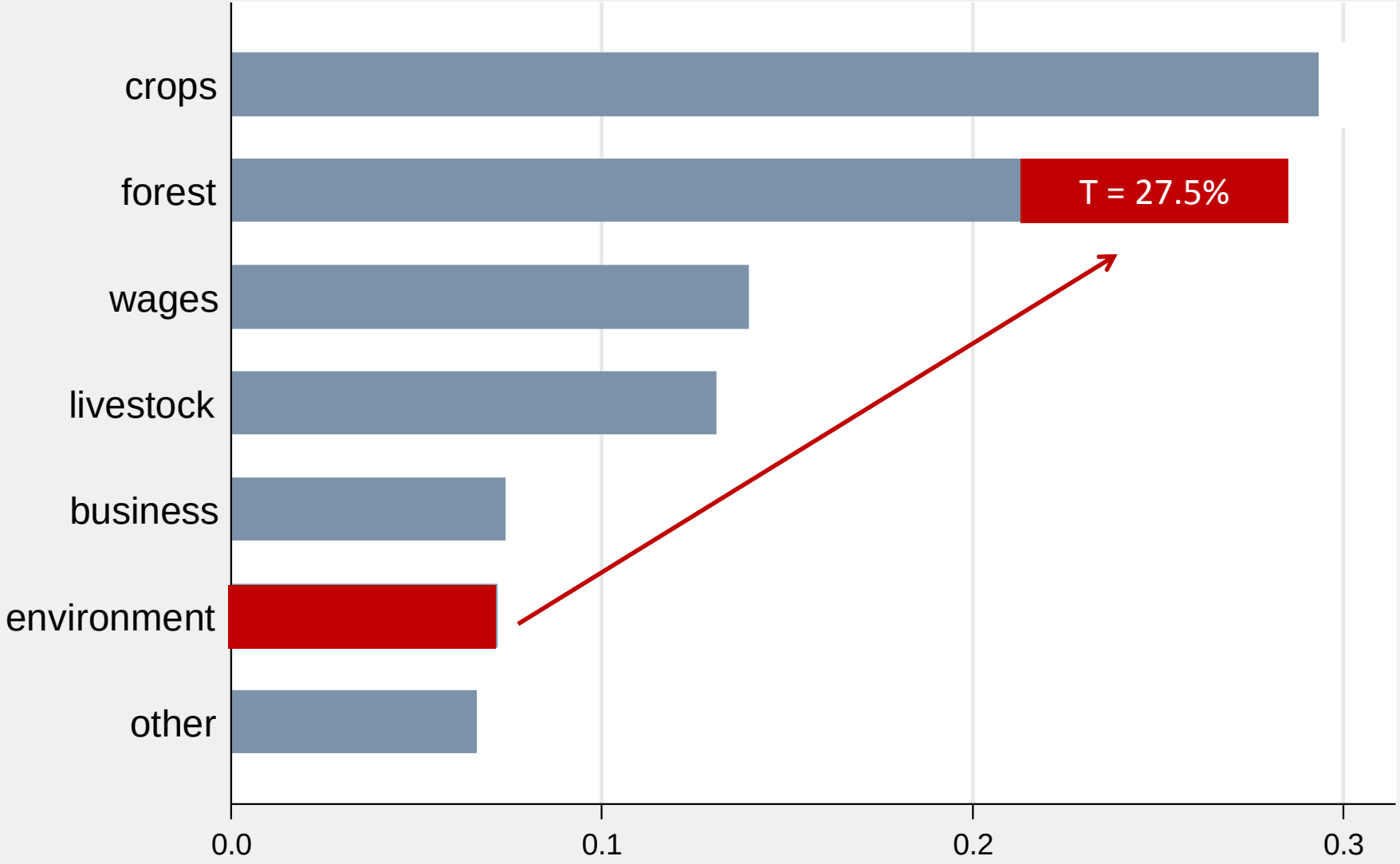
Q1: Do structurally poor households rely more on environmental income?

- Structurally poor have lowest **absolute** income from environmental resources in all regions,
- Asset-poor (structurally poor and stochastically non-poor) have higher income **shares** from environment compared to asset-rich hh – at least in South Asia and Africa

Q2: What role for environmental incomes as a safety net in response to stochastic poverty?

- **Asset-rich** households experiencing an income shortfall do not seem to compensate by more environmental income
- **Asset-poor** households – (prelim) off-farm options more important than env income responses?

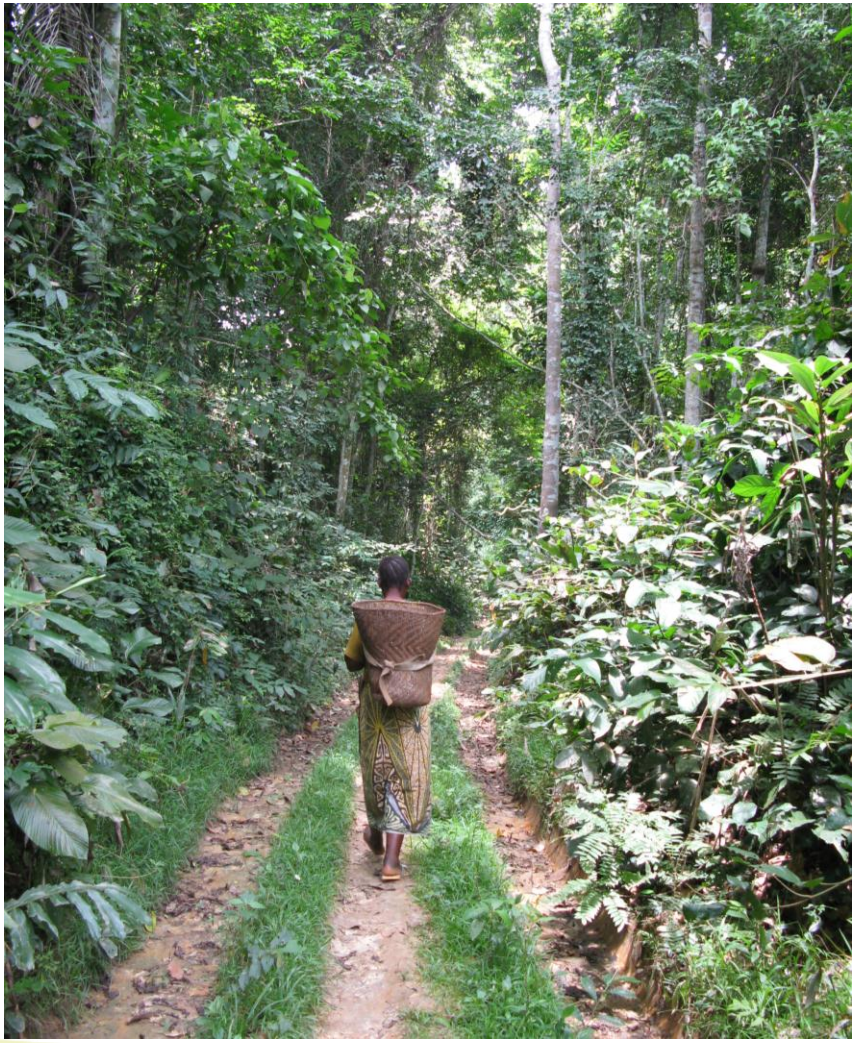
Results: Income sources in the PEN dataset



Source: CIFOR-PEN dataset

=> 14% of our sample households would fall under the 1.25 USD global poverty line without their environmental incomes

The role of extractive incomes:



"More than 10,000 years after the Agricultural Revolution started, millions of rural smallholders across the developing world may still derive as much income from foraging forests and wildlands as from cultivating crops"

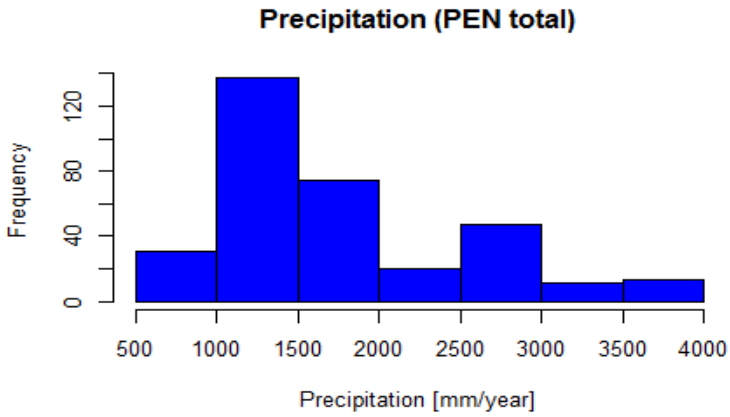
(Wunder, Angelsen, Belcher *World Development* 2014)

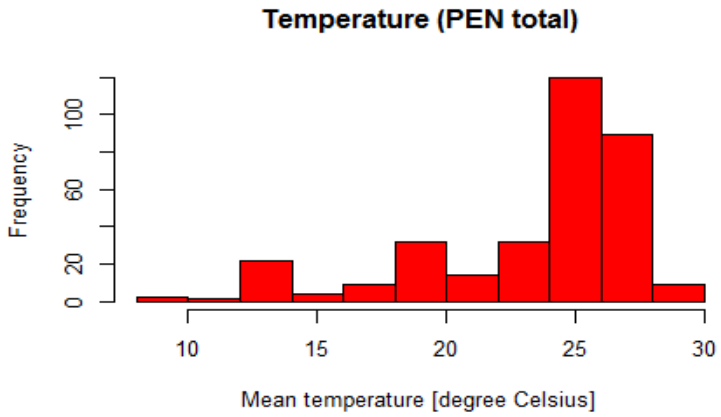
Bringing in the climate

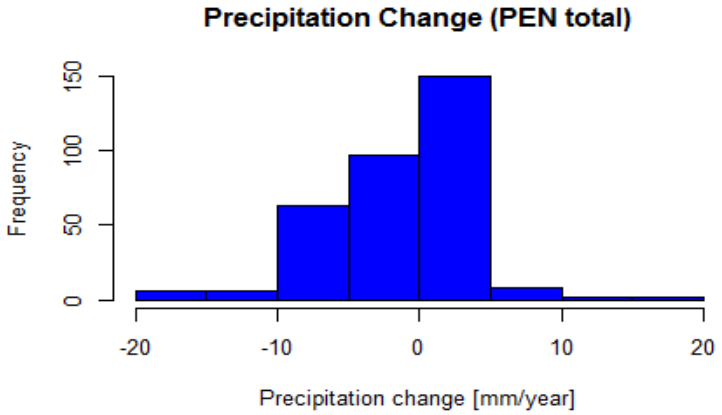
- Using **CRU** data (UEA) for temperature & rainfall – most popular source, but relies much on extrapolated data in the tropics, with fewer station measurements
- Data 30 yr climate time series (pooled data)
- Using **UDEL**, **GPCP**, **GPCC** data for sensitivity analyses (adds also satellite-based data).
- Precipitation harder to extrapolate than temperature! **TRMM** data an alternative for tropics? Cumbersome download – pros & cons

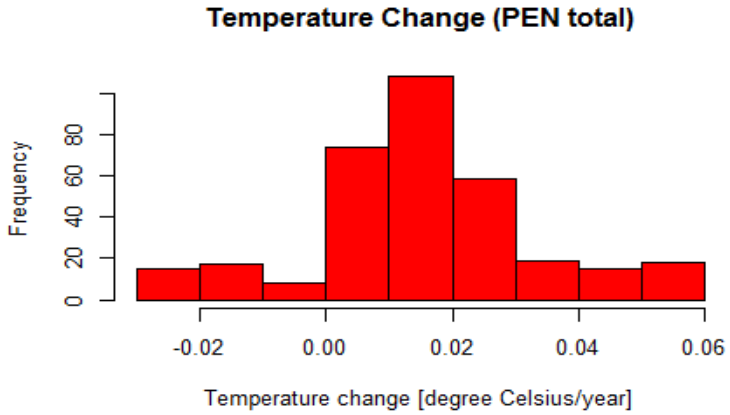
=> No ideal data solution: your feedback, please!

Combining PEN with climate data









=> What st.dev. measures should we use?

Environmental income as safety net?

- Household **self-reported** shocks + ex-post responses
- **Covariate** shocks proxy for climate shocks (major crop failures, livestock or other asset losses) N=10,662
- For only 8% of covariate shocks, more environmental extraction was a major ex-post coping response
- Small, well-educated, and cropland-rich households **less likely** to use extraction as shock response (Probit)
- Village-level high forest income, low distance to urban centers, and Asian households were significantly **more likely** to use extraction as shock response (Probit)

=>HH perceive **rather low** scope for environmental safety nets to shocks

Theory: what expected linkages between climate and household incomes ?

- Households allocate production factors to **activities** (ag., env., other) and choose **technology** (e.g. crops) in ways that are sensitive to **climate** (rainfall, temperature), and its changes over time
- Climate **trends** and **anomalies** have customized income effects – be they positive or negative
- **Environmental** income expectedly less weather dependent than **agricultural** income -more resilient due to (bio)diversity- and other **non-res. income**.

Income regressions: empirical approach

- **Mean** precipitation/ temperature – cross-sectional differences as proxy for climate **trends**
- **Climate anomaly**: deviation of survey year weather from mean weather (30 years), divided by standard weather deviation
- Quadratic Taylor series approximation of climate and weather anomalies.
- OLS **estimation** of climate -> income relation, with standard errors clustered at village level
- Soil attributes, infrastructure, assets, geography as **controls** (in one model specification) – responses to anomalies vs. cross-sectional mean differences.

How do sectoral incomes vary with a changing climate (cross-section)?

- Dependent variable: sectoral + total income
- a) without controls b) with controls (assets, infrastructure, contextual variables, etc.)
- a) ***Ex ante*** adaptation to climate trends/ expected weather (e.g. crop choice)
  b) ***Ex post*** adaptation to anomalies/ unexpected shocks (e.g. labour reallocation)

a) w/o controls

	Agriculture	Environment	Other	Total
temp_mean	385***	-317***	40	109
	(137)	(102)	(72)	(169)
temp_mean²	-10***	8***	-1	-3
	(4)	(3)	(2)	(4)
prec_mean	1183*	-1134	-46	4
	(626)	(800)	(432)	(1165)
prec_mean²	-219	262	16	59
	(139)	(181)	(96)	(259)
temp_anomaly	-317**	585***	351***	618**
	(142)	(169)	(111)	(266)
temp_anomaly²	-129	28	115	14
	(140)	(129)	(100)	(221)
prec_anomaly	-243***	-57	-33	-333***
	(77)	(69)	(41)	(107)
prec_anomaly²	-11	17	-7	-1
	(30)	(21)	(22)	(40)
R^2	0.08	0.11	0.26	0.25
N	7978	7978	7978	7978
Controls	no	no	no	no

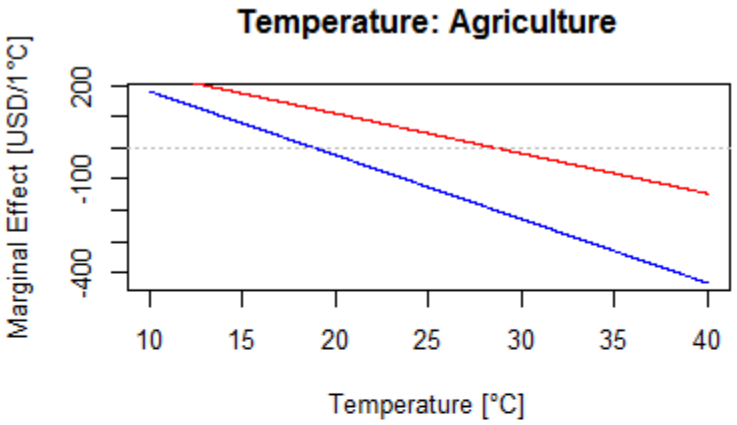
***p < 0.01, **p < 0.05, *p < 0.1

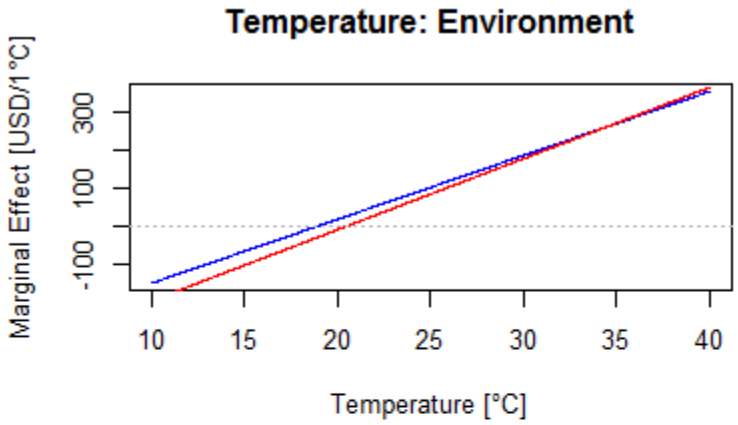
a) with controls

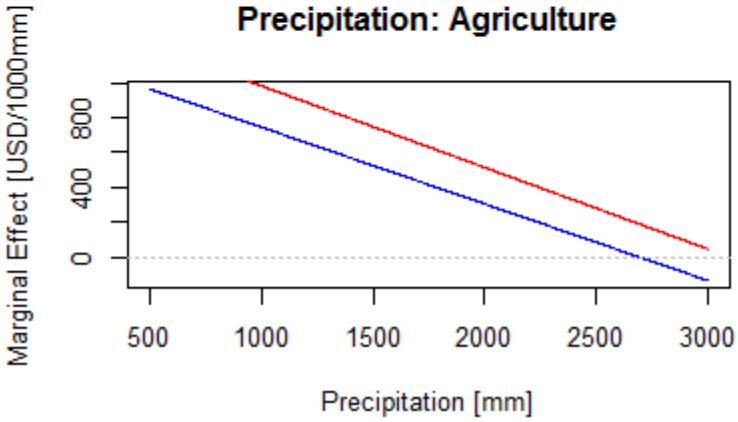
	Agriculture	Environment	Other	Total
temp_mean	161	-363**	149	-54
	(178)	(153)	(121)	(271)
temp_mean²	-2	9**	-4	3
	(4)	(4)	(3)	(6)
prec_mean	1666**	-1410	-533	-277
	(733)	(1120)	(704)	(1412)
prec_mean²	-265*	299	121	155
	(152)	(252)	(143)	(306)
temp_anomaly	-406***	546***	64	203
	(138)	(166)	(165)	(269)
temp_anomaly²	-174	131	57	14
	(142)	(125)	(141)	(248)
prec_anomaly	-176**	-87	-30	-293**
	(80)	(88)	(58)	(122)
prec_anomaly²	32	18	6	56
	(23)	(34)	(28)	(47)
R^2	0.13	0.11	0.32	0.30
N	6616	6616	6616	6616
Controls	✓	✓	✓	✓

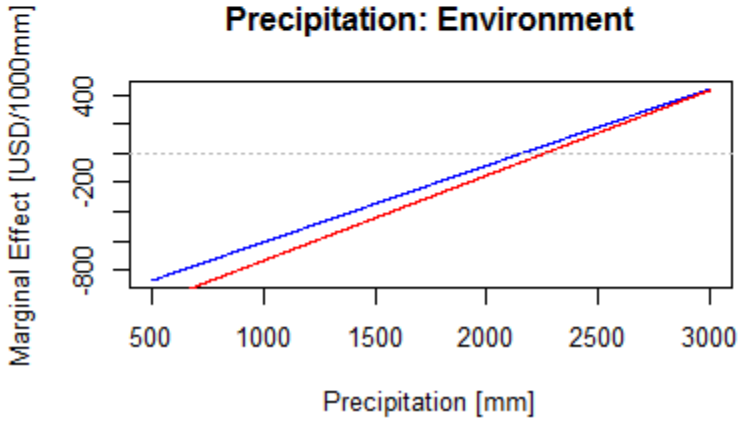
***p < 0.01, **p < 0.05, *p < 0.1

Marginal effects of climate trends









=> Ag. vs. env income: a substitutive relation?

Preliminary conclusions (1)

- *RQ1: What environmental dependence of the rural poor and vulnerable? (static cross-section)*
- Extraction of wild resources provides as much income (~27%) as crops in our pantropical smallholder sample
- The poorest/ most vulnerable households rely relatively more on env. incomes, though they generate less of it than the better-off hh in absolute terms
- 1 in 7 hh. is raised above 1.25 USD by env. income
- Env. income plays not much role as a safety net in hh. self-stated response to co-variate (incl. climate) shocks

Preliminary conclusions (2)

- *RQ2: What likely effect of climate change on livelihood vulnerability of the rural poor? (dynamically predictive)*
- Over last 30 yr, still small rise in average temperature; more shifts in/ income impact of precipitation patterns
- Environmental incomes may in part substitute for ag. income declines, as long as climate change is limited…
- …and shock (as well as population) densities remain low (higher extraction pressures sustainable?)
- Little sensitivity so far of total hh incomes to climate change (trends, anomalies) shows adaptive capacity
- Education and other investments in off-farm sectors may eventually be needed to adapt effectively

Thinking beyond the canopy

www.cifor.org/pen

Center for International Forestry Research