Rough guide to impact evaluation: from correlation to causation

Subhrendu K. Pattanayak
with ***Daniela Miteva***
Duke University
EfD-World Bank Workshop, April 2011

Preview two main claims

I. Allocate more of our research efforts to good impact evaluations

II. Collaborate with climate & health scientists to consider fuel wood as part of the bigger picture

Readings & Key Resources

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Essay

Money for Nothing? A Call for Empirical Evaluation of Biodiversity Conservation Investments

Paul J. Ferraro*, Subhrendu K. Pattanayak*

For far too long, conservation scientists and practitioners have depended on intuition and anecdote to guide the design of conservation investments. If we want to ensure that our limited resources make a difference, we must accept that testing hypotheses about what policies protect biological diversity requires the same scientific rigor and state-of-the-art methods that we invest in testing ecological hypotheses. Our understanding of the ecological aspects of ecosystem conservation rests, in part, on well-designed empirical studies. In contrast, our understanding of the way in which policies can prevent species loss and ecosystem degradation rests primarily on case-study narratives from field initiatives that are not designed

We are not advocating that every conservation intervention be evaluated with the methods we describe below. We are merely advocating that *some* of the hundreds of biodiversity conservation initiatives initiated each year are evaluated with these methods. While there are challenges to field implementation of the methods, their use is no more expensive or complicated than biological assessments. Their promise lies in complementing case study narratives and testing intuition.

Why Do We Need Evaluations?

Budgets for biodiversity conservation are thinly stretched [2], and thus judging the effectiveness of conservation interventions in

Box 1. Example from the Development and Education Policy Literature

Does reducing the cost of schooling increase student attendance? [30]

Initiated in the 1990s, the Mexican PROGRESA program provides cash grants to families if their children attend school regularly and receive preventative health care. The program was phased in randomly across villages. Analysts observed an average increase in enrollment of 3.4% for all students in grades 1 through 8, and 14.8% among girls who had completed grade 6. Using these same data, more sophisticated analyses were also done ("What would happen if the payments increased?"). In part, these clear and credible estimates of PROGRESA's effect led the Mexican

Chapter 22

Learning while doing

Evaluating impacts of REDD+ projects

Pamela Jagger, Stibniati Atmadja, Subhrendu K. Pattanayak, Erin Sills and William D. Sunderlin

- REDD+ projects require an impact assessment approach to estimate emissions and removals; for REDD+ to succeed we need information on this and the associated 3E+ outcomes.
- There are few examples of rigorous impact assessment in the conservation, avoided deforestation and payments for environmental services (PES) literature. REDD+ impact assessment could contribute tremendously to our understanding of successful environment and development policy initiatives.
- We will learn more rapidly and effectively by sharing evaluation designs and findings across REDD+ projects.

How will learning from projects improve REDD+?

We have a narrow, but critical, window of opportunity to evaluate and learn from the experience of first generation REDD+ projects. By gathering evidence on processes and outcomes, we will learn what causes REDD+ projects to succeed or fail. REDD+ is a unique opportunity to share the lessons we learn, because of the global distribution and relatively coordinated timing of

Evaluating Anti-Poverty Programs

Martin Ravallion[1]

Development Research Group, World Bank

Abstract: The paper critically reviews the methods available for the *ex-post* counterfactual analysis of programs that are assigned exclusively to individuals, households or locations. The discussion covers both experimental and non-experimental methods (including propensity-score matching, discontinuity designs, double and triple differences and instrumental variables). Two main lessons emerge: Firstly, despite the claims of advocates, no single method dominates; rigorous, policy-relevant evaluations should be open-minded about methodology. Secondly, future efforts to draw more useful lessons from evaluations will call for more policy-relevant measures and deeper explanations of measured impacts than are possible from the classic ("black box") assessment of mean impact.

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A guide to learning about livelihood impacts of REDD+ projects

Pamela Jagger
Erin O. Sills
Kathleen Lawlor
William D. Sunderlin

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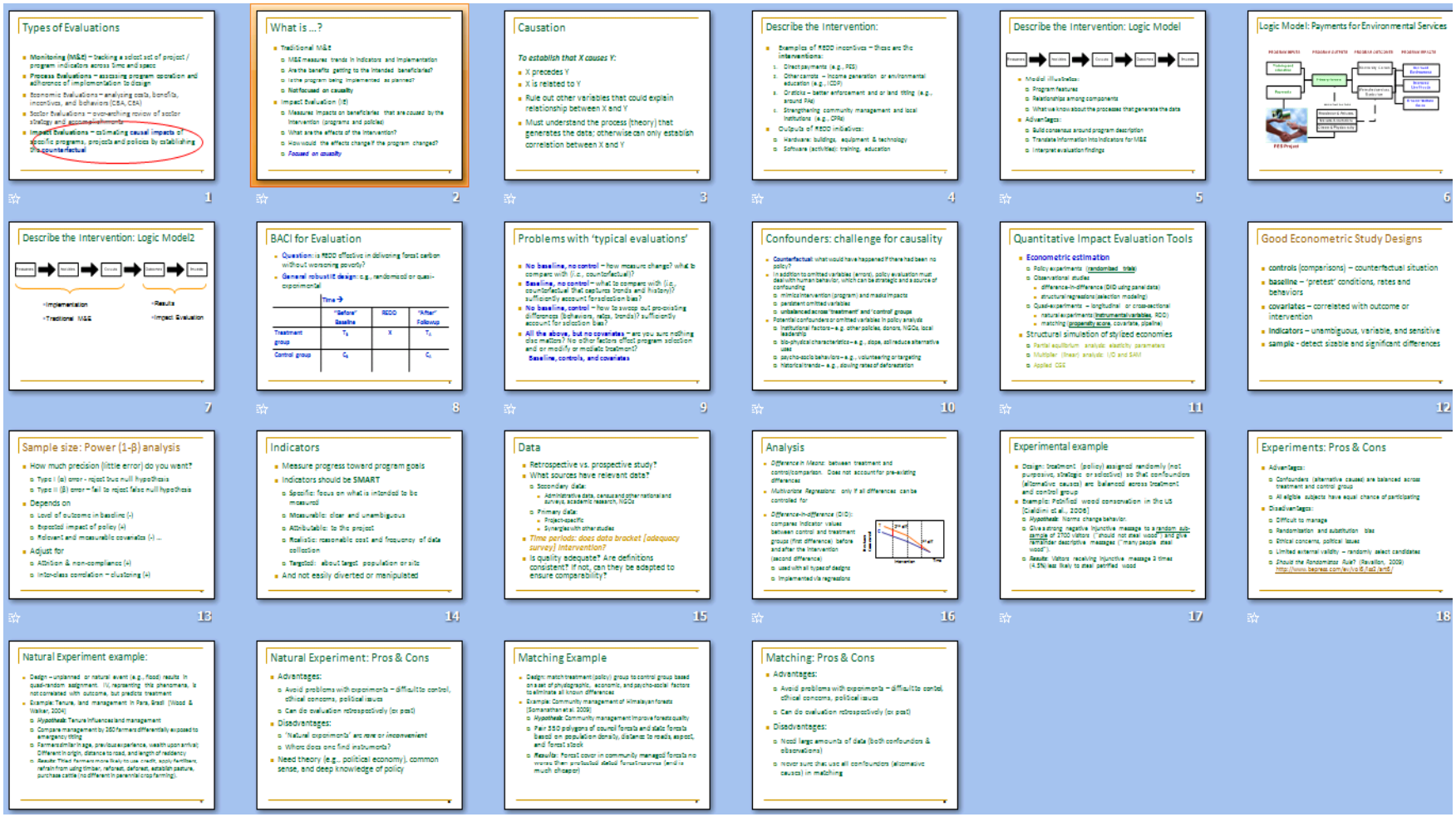
“Good” impact evaluation

… will allow you to confidently describe …

- Is intended intervention “working” – i.e., effective in delivering intended outcomes (forest incomes, reduced deforestation, fuelwood extraction)?
- *Conditional on design, sample and analysis*
  - what types of incentives and activities are most effective?
  - who benefits (loses) and or delivers most?
  - where (sites) and when (point in project cycle) will we see best results?

Nuts & bolts:
framework, data, sample, design, analysis



Study	Location	Design	Intervention	Sample	Method	Outcome
Edmonds (2002)	Nepal	Cross-sectional	Decentralization	1200 households	Matching, IV	Fuelwood extraction
Heltberg (2001)	India	Cross-sectional	Local institutions	180 households, 32 forests	IV	Forest degradation, household dependence on nat. resources
Burgess et al (2011)	Indonesia	Multi-period	Decentralization (# political jurisdictions)	Large # pixels	Poisson quasi-likelihood count model	Deforestation
Somanathan et al (2009)	India	Cross-sectional	State vs. council managed forests	271 villages, 582 observations for broad-leafed crown cover, 504 observations for pine forest	IV, Matching	Forest conservation, cost of conservation
Baland et al (2010)	India	Cross-sectional	Decentralization	83 villages, 399 forest observations	OLS, conditional logit w/ FE	Forest degradation

Study	Location	Design	Intervention	Sample	Method	Outcome
Jagger (2008)	**Uganda**	**2 period, pooled cross-sectional**	**Decentralization**	**751 households**	**DID, tobit**	**Livelihoods**
Jumbe & Angelsen (2007)	Malawi	Cross-sectional	Decentralization	404 households	Matching	Livelihoods
Coleman et al (2010)	Uganda, Kenya, Mexico, Bolivia	2 periods (before and after), not panel	Decentralization	303 user groups for the 4 countries	Probit, Matching	Forest condition, Investment decisions, rule-making, wealth inequality (all binary)
Anderson & Gibson (2006)	Bolivia	Cross-sectional	National vs. local institutions	30 observations, 2 period GIS data	IV	Deforestation measures
Andam et al (2008)	Costa Rica	Multi-period data (forest cover data for 3 years)	Protected areas	>2000 pixels	Matching	Deforestation

Forest Income after Uganda's Forest Sector Reform: Are the Rural Poor Gaining?

- Context
  - Uganda leading decentralization reforms in sub-Saharan Africa
  - Forest sector reform focused on poverty reduction
  - Decentralization theory is mixed regarding whether poverty reduction is an expected outcome
  - Very limited empirical evidence on quantitative outcomes of decentralization reforms

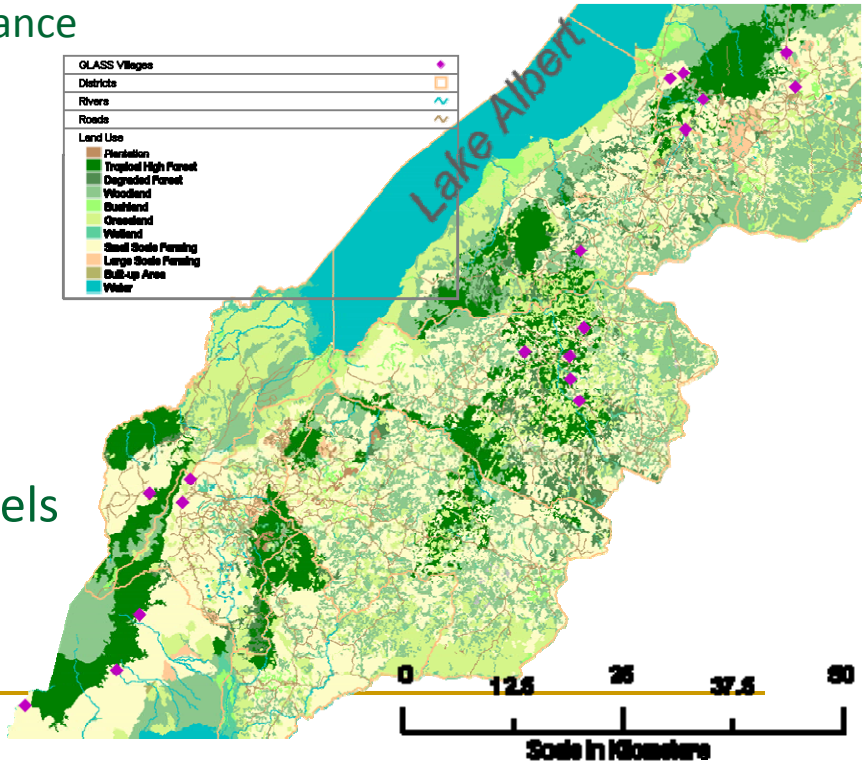
- Research question: Does forest sector decentralization increase forest income for the rural poor?

Source: Jagger (2008)

Data and approach

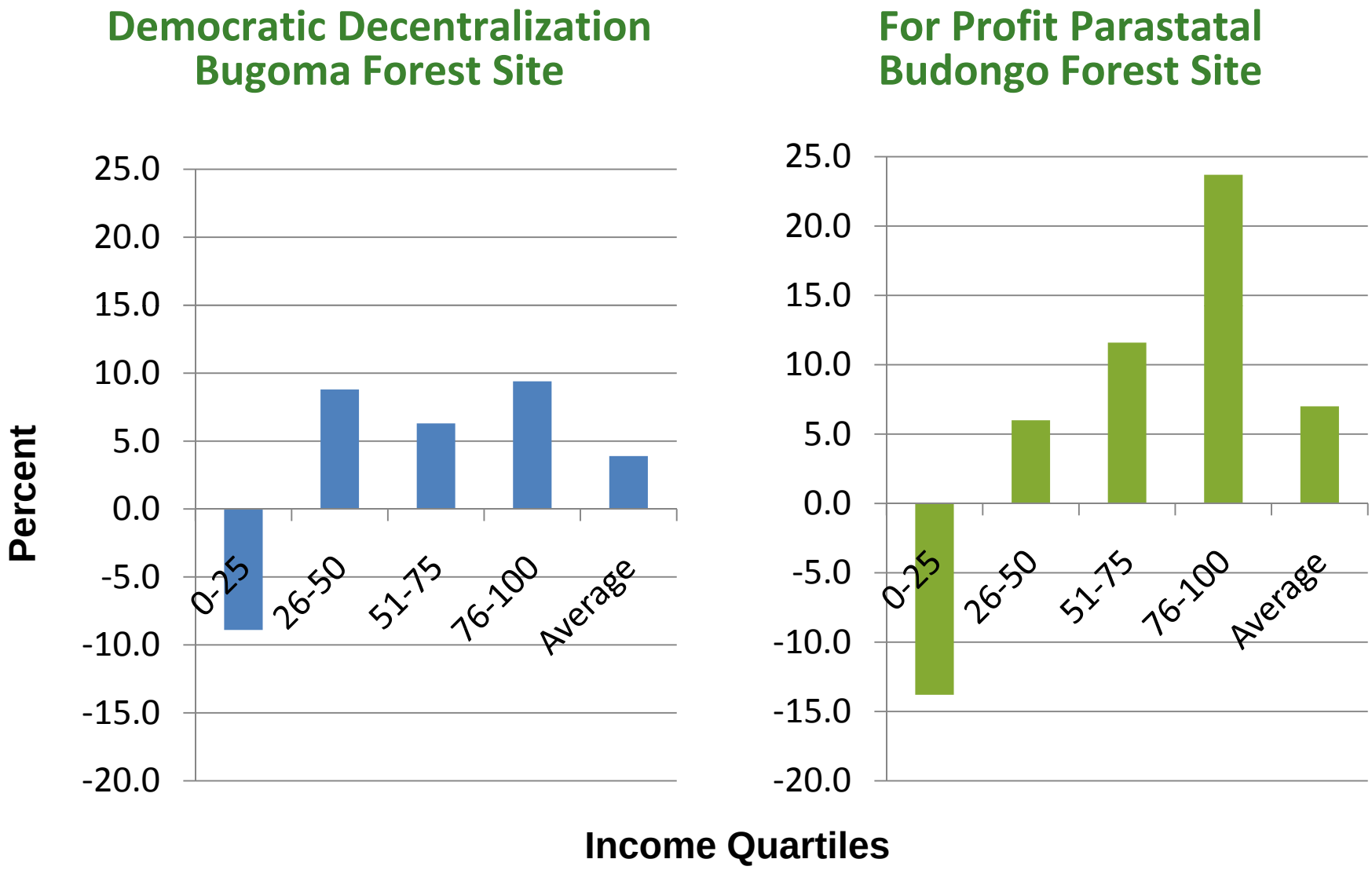
- Quasi-experimental design
  - Post-reform household income portfolio data (2007, N=521) compared with pre-reform data (2003, N=256)
  - Two treatment groups
    - Democratic decentralization (private forest)
    - For-profit parastatal (gazetted forest)
  - Control group
    - National Park under centralized governance
- Treatment groups modeled in comparison to control group using the **difference-in-difference estimator**
  - Double-difference means (DID)
  - Conditional difference-in-difference estimates using Tobit regression models

Study area in western Uganda



Source: Jagger (2008)

Average change in share of hhd income from forests (DID)



Source: Jagger (2008)

Conditional difference-in-difference estimates

Democratic Decentralization to District Forestry Service

- **Increase of $5** annual household income from forests
- **Increase of 3.1%** in share of annual household income from forests

- **Highest income quartile households:**
  - Increases in forest income **(+$30)**
  - Increase in share of total income from forests **(+11.6%)**
- **Lowest income quartile households:**
  - Decline in income from forests **(-$10)**
  - Significant declines in share of income from forests **(-10.7%)**

Devolution to National Forestry Authority (for-profit parastatal)

- **Increase of $53** annual household income from forests
- **Increase of 6.4%** in share of annual household income from forests

- **Highest income quartile households:**
  - Significant increases in forest income **(+$162)**
  - Significant increases in share of total income from forests **(+25%)**
- **Lowest income quartile households:**
  - Significant declines in income from forests **(-$15)**
  - Significant declines in share of income from forests **(-15%)**

Source: Jagger (2008)

II. Collaborate with climate & health scientists to consider fuel wood as part of the bigger picture

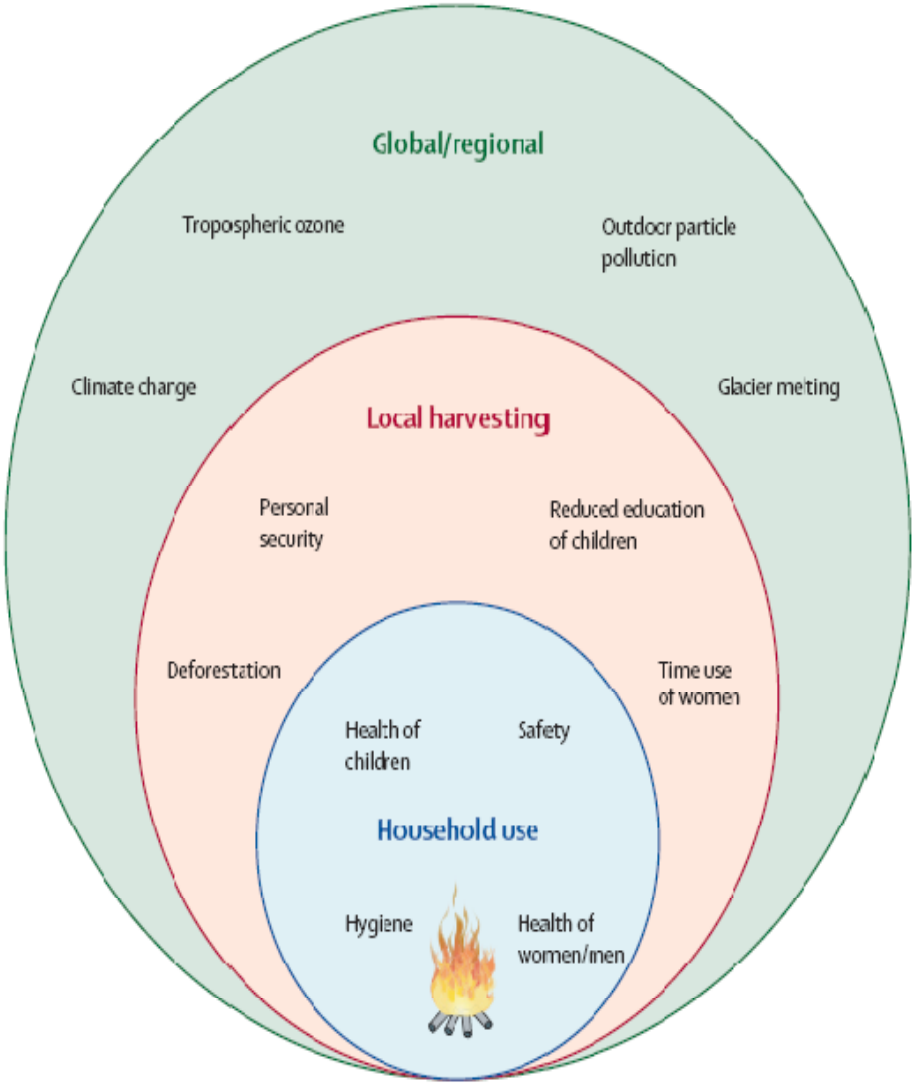
(drawn from *Household Health & Energy* Initiative at Duke University)

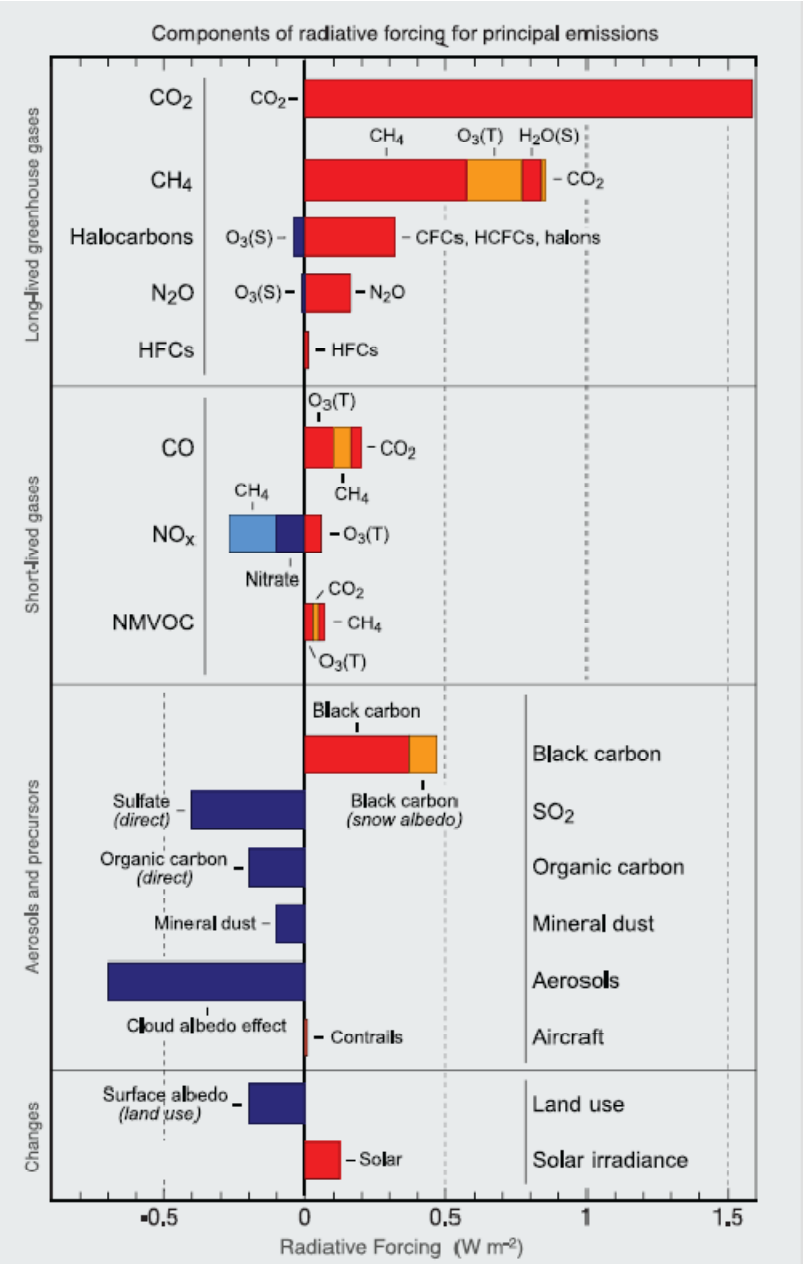
Triple Dividends of Fuelwood

I. Black Carbon

II. Household Health

III. Local Forests





Role of Black Carbon in Global and Regional Climate Changes

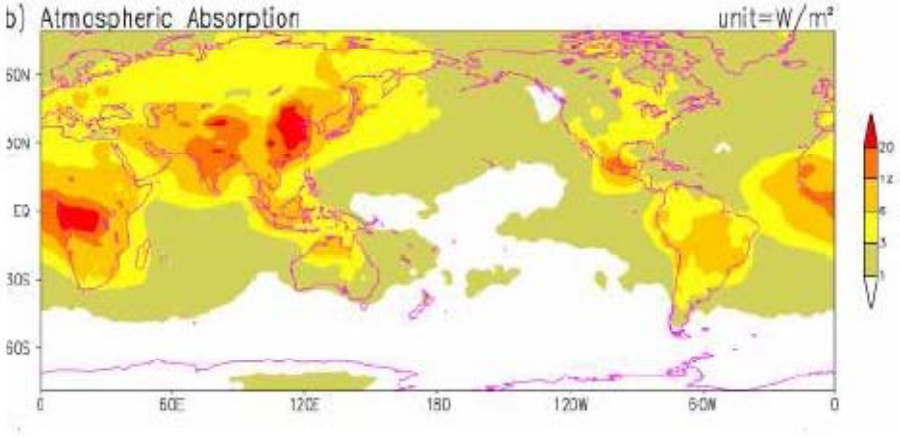
V. Ramanathan
Scripps Institution of Oceanography
University of California at San Diego

Testimonial to the House Committee on Oversight and Government Reform
Chair: The Honorable Henry A Waxman

Hearing on the role of black carbon as a factor in climate change

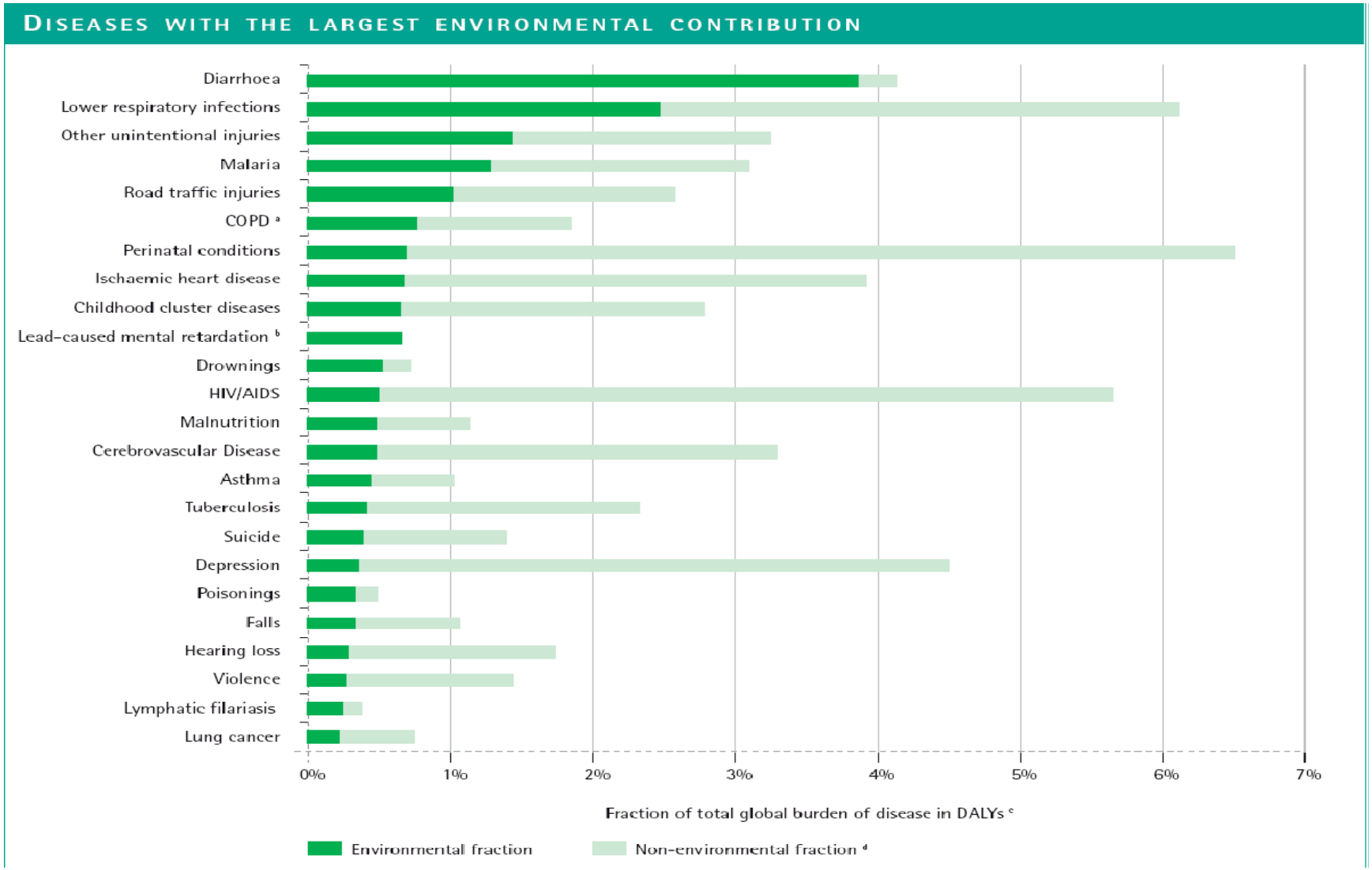
Thursday, October 18, 2007 Rayburn House Office Building, Washington DC

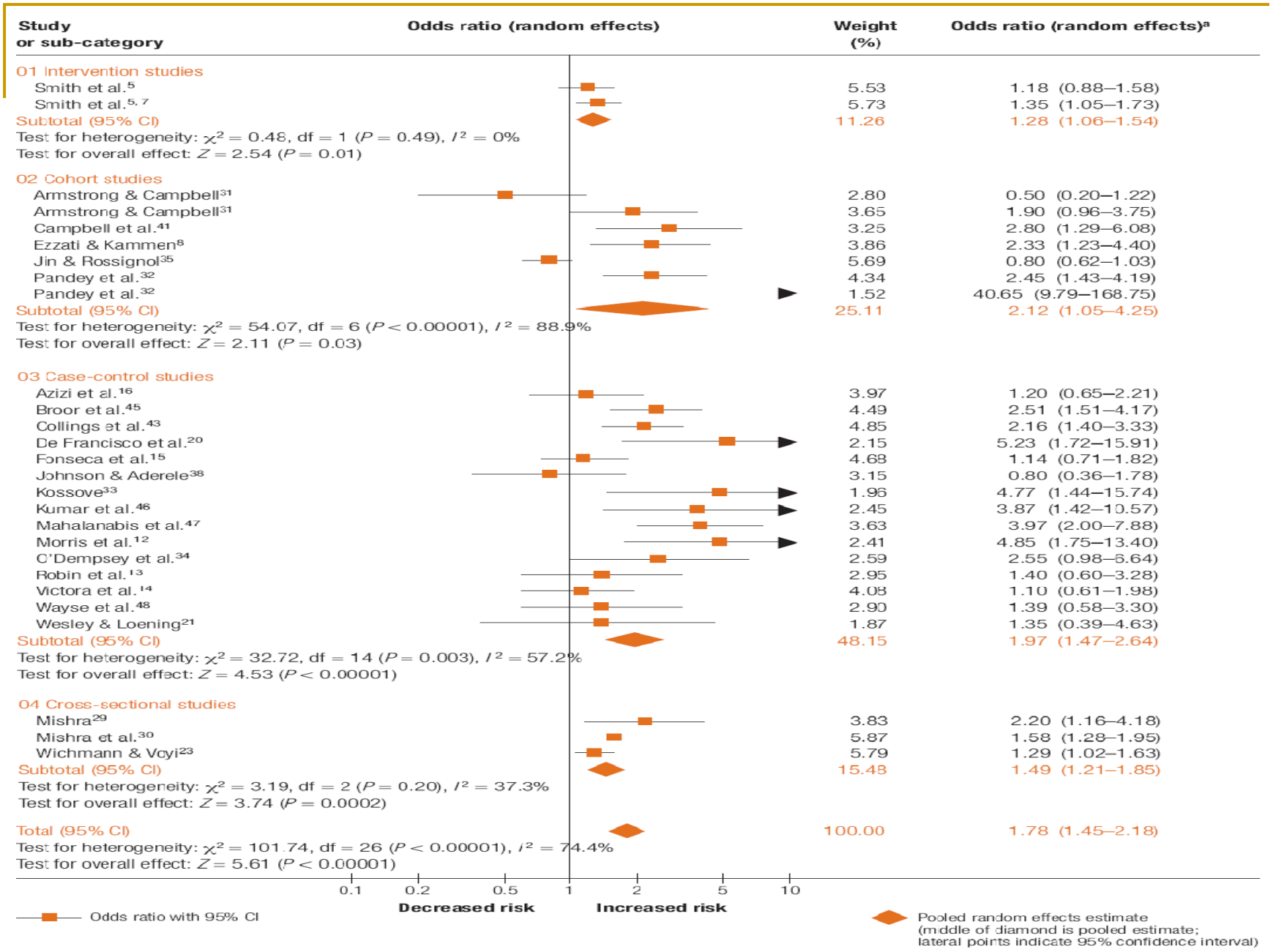
Some of the material in this paper is extracted from lectures given at the Pontifical Academy of Sciences, Vatican, (2006), the Bjerknes lecture given at the AGU fall symposium in San Francisco (2006) and a keynote talk at the *17th International Conference on Nucleation and Atmospheric Aerosols, Galway, Ireland (2007)*



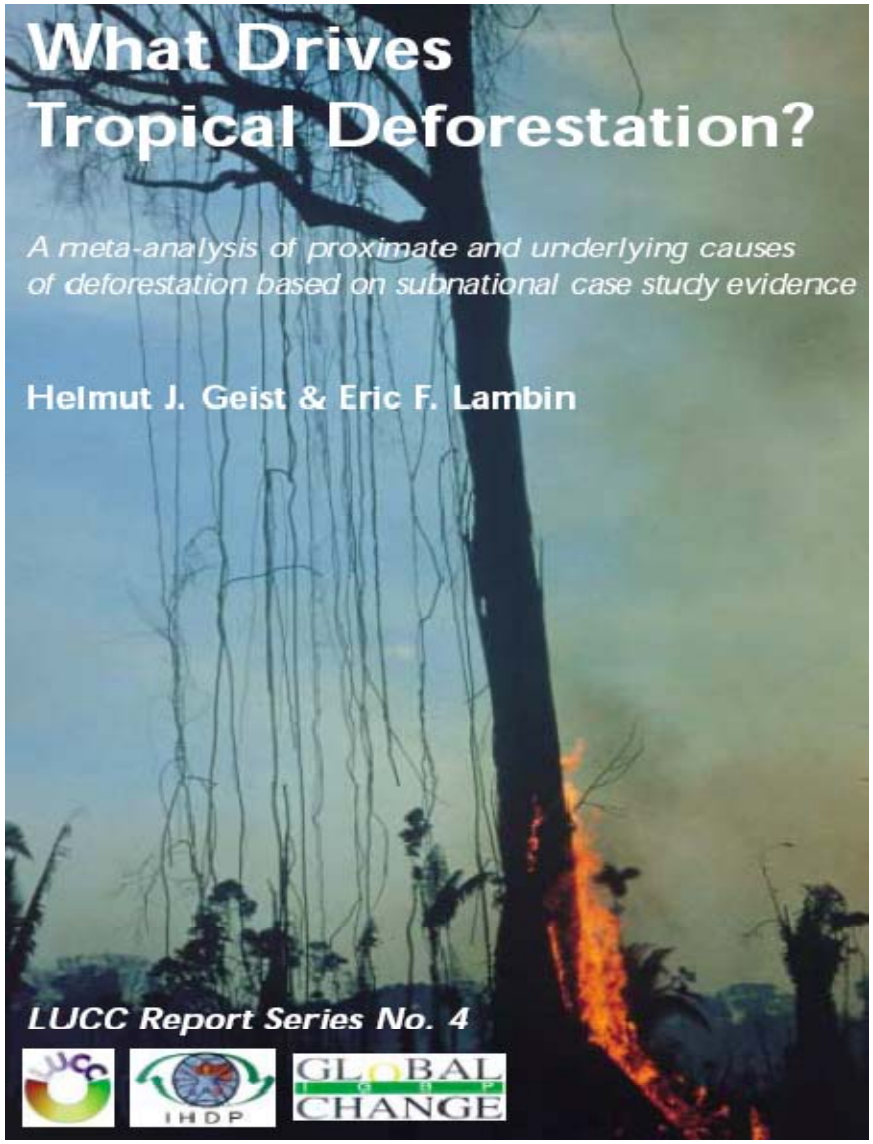
Atmospheric Solar Heating (Wm^{-2}) by Black Carbon for the period 2000-2003.

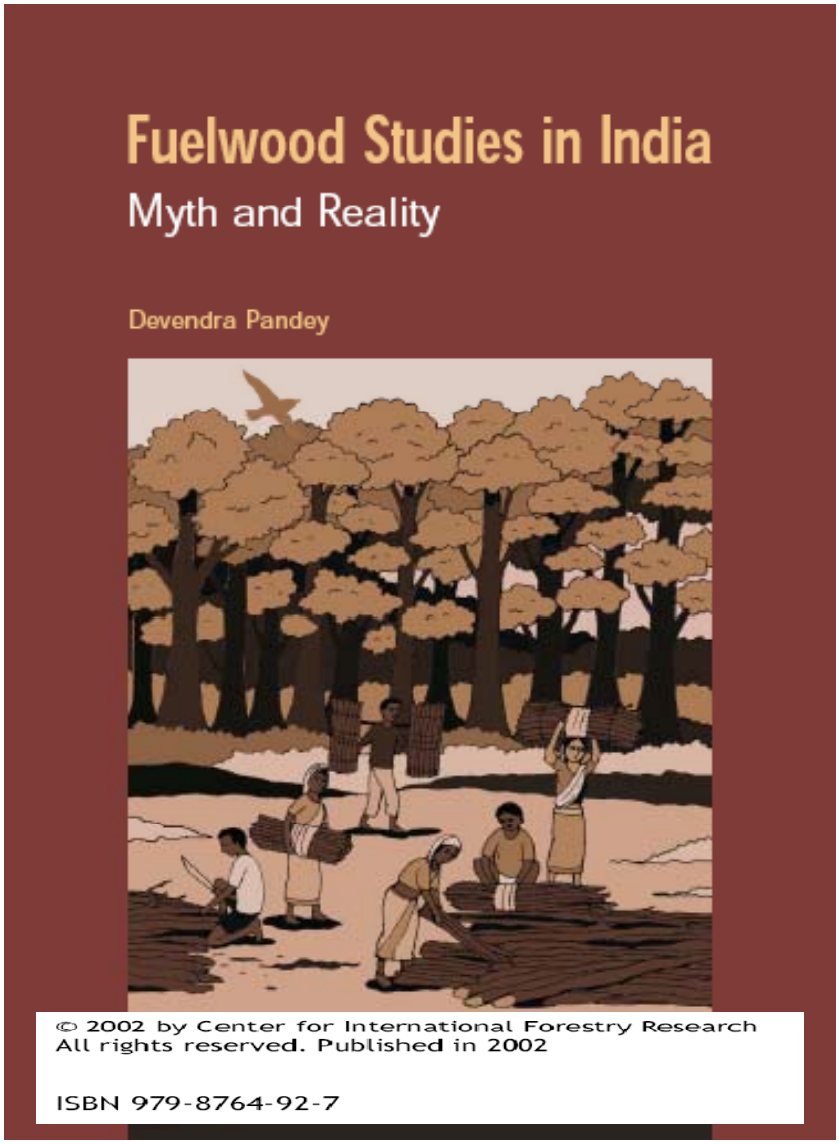
Environmental Burden: WHO 2006




Study or sub-category
Odds ratio (random effects)
Weight (%)
Odds ratio (random effects)[a]
01 Intervention studies
Smith et al.[5] 5.53 1.18 (0.88–1.58)
Smith et al.[5, 7] 5.73 1.35 (1.05–1.73)
Subtotal (95% CI) 11.26 1.28 (1.06–1.54)
Test for heterogeneity: $\chi^2 = 0.48$, df = 1 ($P = 0.49$), $I^2 = 0\%$
Test for overall effect: $Z = 2.54$ ($P = 0.01$)
02 Cohort studies
Armstrong & Campbell[31] 2.80 0.50 (0.20–1.22)
Armstrong & Campbell[31] 3.65 1.90 (0.96–3.75)
Campbell et al.[41] 3.25 2.80 (1.29–6.08)
Ezzati & Kammen[8] 3.86 2.33 (1.23–4.40)
Jin & Rossignol[35] 5.69 0.80 (0.62–1.03)
Pandey et al.[32] 4.34 2.45 (1.43–4.19)
Pandey et al.[32] 1.52 40.65 (9.79–168.75)
Subtotal (95% CI) 25.11 2.12 (1.05–4.25)
Test for heterogeneity: $\chi^2 = 54.07$, df = 6 ($P < 0.00001$), $I^2 = 88.9\%$
Test for overall effect: $Z = 2.11$ ($P = 0.03$)
03 Case-control studies
Azizi et al.[16] 3.97 1.20 (0.65–2.21)
Broor et al.[45] 4.49 2.51 (1.51–4.17)
Collings et al.[43] 4.85 2.16 (1.40–3.33)
De Francisco et al.[20] 2.15 5.23 (1.72–15.91)
Fonseca et al.[15] 4.68 1.14 (0.71–1.82)
Johnson & Aderele[38] 3.15 0.80 (0.36–1.78)
Kossove[33] 1.96 4.77 (1.44–15.74)
Kumar et al.[46] 2.45 3.87 (1.42–10.57)
Mahalanabis et al.[47] 3.63 3.97 (2.00–7.88)
Morris et al.[12] 2.41 4.85 (1.75–13.40)
O'Dempsey et al.[34] 2.59 2.55 (0.98–6.64)
Robin et al.[13] 2.95 1.40 (0.60–3.28)
Victora et al.[14] 4.08 1.10 (0.61–1.98)
Wayse et al.[48] 2.90 1.39 (0.58–3.30)
Wesley & Loening[21] 1.87 1.35 (0.39–4.63)
Subtotal (95% CI) 48.15 1.97 (1.47–2.64)
Test for heterogeneity: $\chi^2 = 32.72$, df = 14 ($P = 0.003$), $I^2 = 57.2\%$
Test for overall effect: $Z = 4.53$ ($P < 0.00001$)
04 Cross-sectional studies
Mishra[29] 3.83 2.20 (1.16–4.18)
Mishra et al.[30] 5.87 1.58 (1.28–1.95)
Wichmann & Voyi[23] 5.79 1.29 (1.02–1.63)
Subtotal (95% CI) 15.48 1.49 (1.21–1.85)
Test for heterogeneity: $\chi^2 = 3.19$, df = 2 ($P = 0.20$), $I^2 = 37.3\%$
Test for overall effect: $Z = 3.74$ ($P = 0.0002$)
Total (95% CI) 100.00 1.78 (1.45–2.18)
Test for heterogeneity: $\chi^2 = 101.74$, df = 26 ($P < 0.00001$), $I^2 = 74.4\%$
Test for overall effect: $Z = 5.61$ ($P < 0.00001$)
0.1
0.2
0.5
1
2
5
10
Decreased risk
Increased risk
Odds ratio with 95% CI
Pooled random effects estimate
(middle of diamond is pooled estimate;
lateral points indicate 95% confidence interval)

Meta-Analyses of Deforestation





How can emissions from woodfuel be reduced?

Ole Hofstad, Gunnar Köhlin and Justine Namaalwa

Policy intervention	Effectiveness	Efficiency	Equity	Co-benefits
Cooking efficiency	Moderate	High	Hurts the poorest consumers if not subsidised	Better health, less local air pollution
Fuel substitution	High for clean energy, low for fossil fuels	Costly for clean energy, cheaper for fossil fuels	Hurts the poorest consumers if prices not differentiated	Better health, less local air pollution
Production efficiency	Moderate, must be combined with harvest control	High, if combined with harvest control	Hurts producers without capital	Less local air pollution
Controlling harvest	Low if centralised, higher if devolved	Low if centralised, higher if devolved	May benefit the rural poor, but elite capture possible	May benefit biodiversity in some areas
Plantations	High	Low, if harvest in indigenous forests is not controlled	Benefits land owners and producers with capital	Sequester carbon if planted on land with low biomass density

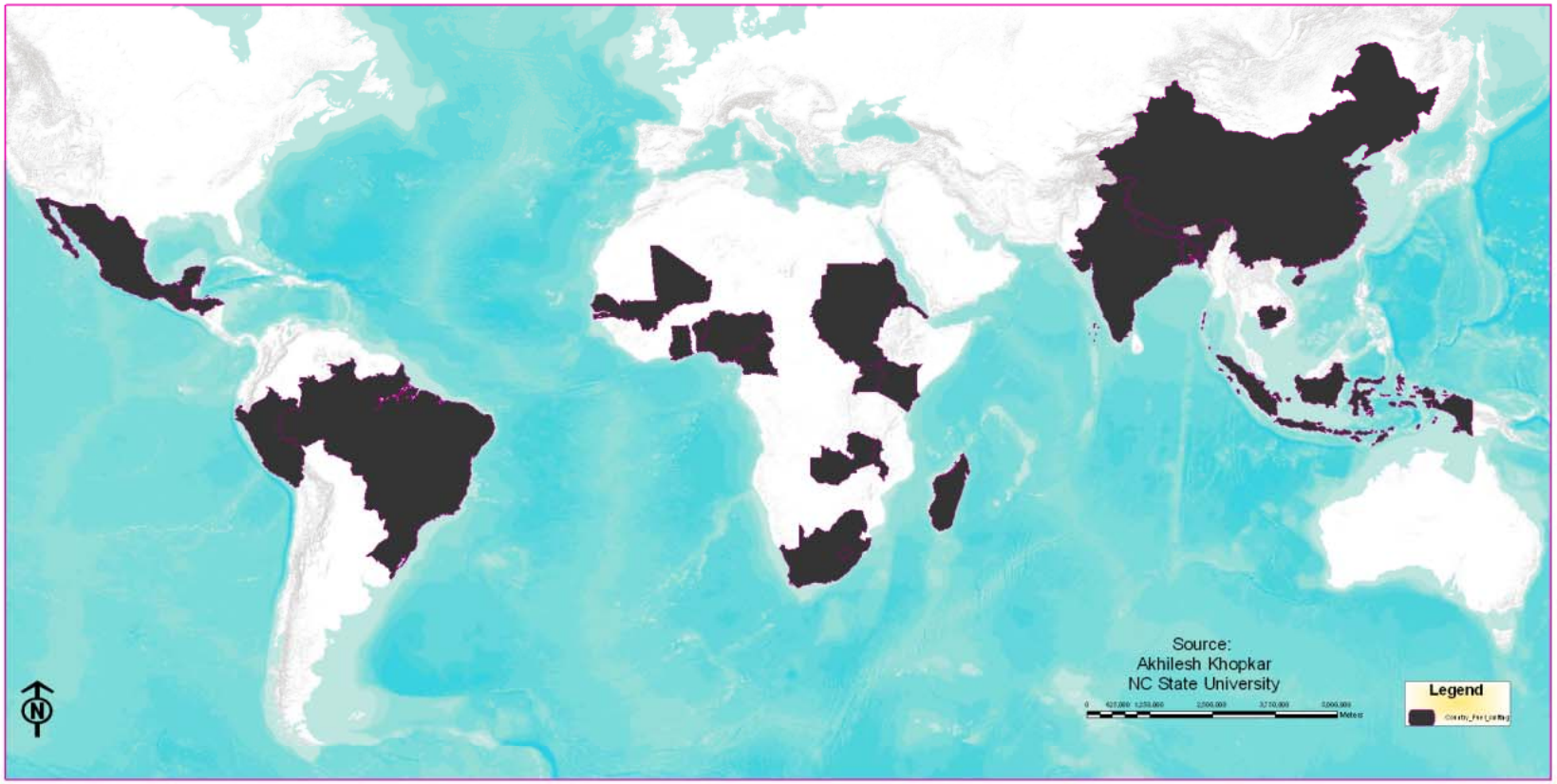
- 33/152 case studies suggest that fuelwood extraction is a proximate cause of deforestation
- 75% of the global fuel wood consumption (*mostly* in Asia and Africa) led to localized deforestation
- Initial stove promotion prompted by deforestation concerns (Barnes et al., 1993) over-reaching – no global shortage of fuelwood availability
- Mix of demand (e.g., cookstoves) & supply (e.g., CBNRM) policies
- Lacking systematic rigorous evidence that rural energy use causes deforestation or degratdation

Do ICS reduce fuelwood collection?

STUDY	LOCATION	IMPACT	MODEL
Chen et al. 2006 (ECOLECON)	Jiangxi, China	0 & +	tobit with few controls (N = 190 hh)
Heltberg et al., 2000 (LAND)	Rajasthan, India	0	maximum entropy, few controls (N = 174 hh)
Edmonds, 2002 (JDE)	Arun valley, Nepal	_	OLS with many controls (N = 1200 hh)
Pattanayak et al., 2004 (EDE)	Flores, Indonesia	_	probit with linear controls (N ~ 500 hh)
Mekonnen & Kohlin 2010	Tigray, Ethiopia	_§	RE with many controls (N = 1400 hh)
Heltberg, 2004 (ENERGYECON)	Ghana, rural	_§	MNlogit with few controls (N = 3760 hh)
Heltberg, 2004 (ENERGYECON)	Brazil, rural	_§	MNlogit with few controls (N = 1080 hh)
Edwards-Langpap, 2005 (LAND)	Guatemala	_	tobit with few controls (N > 6000 hh)

Carbon Finance & Climate Change is Coming!

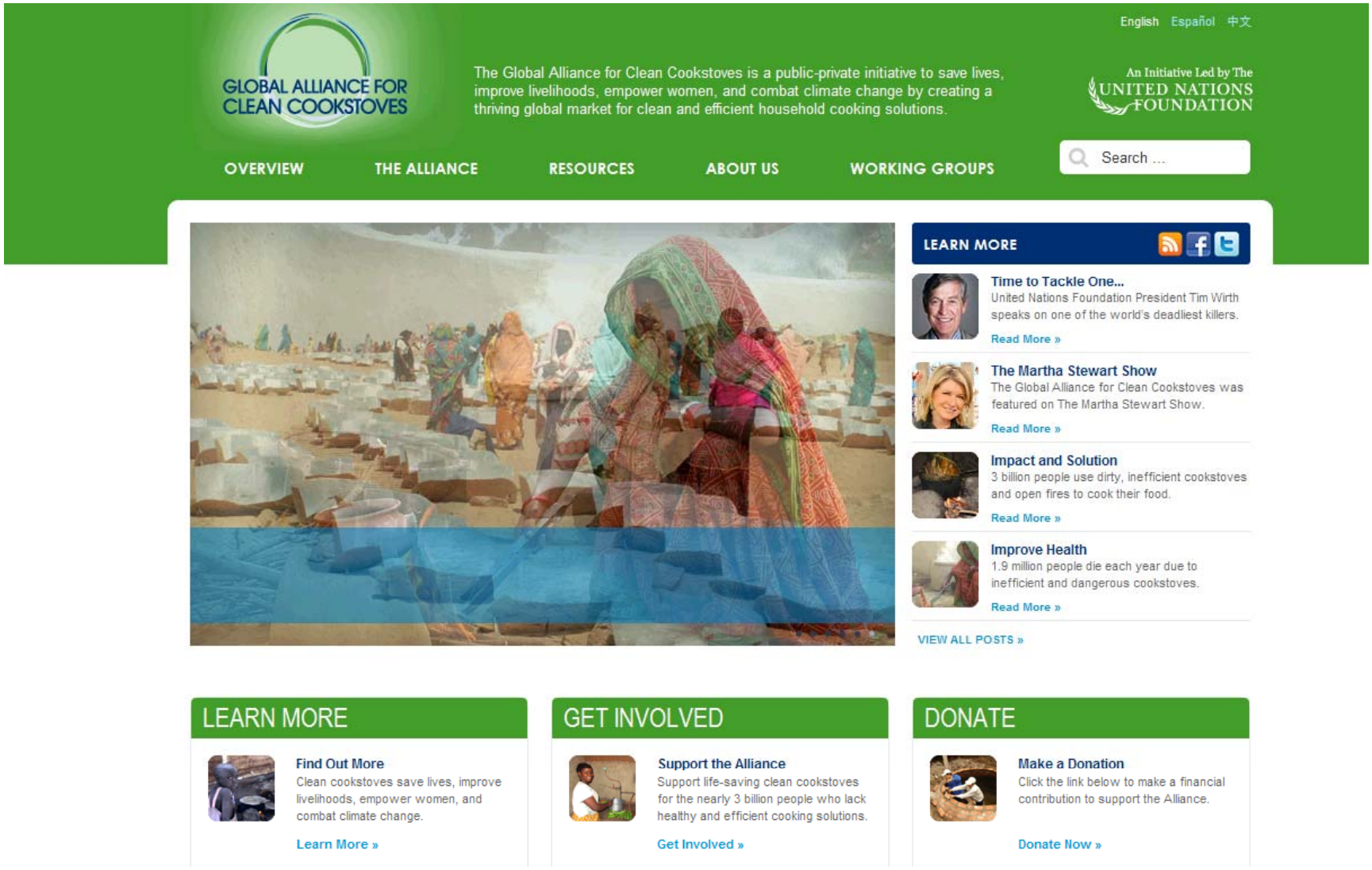
Countries with CDM, VCS, and Gold Standard VER Projects that Aim to Reduce Forest Degradation by Switching Fuel Source or Introducing More Efficient Stoves



Source: Khopkar & Sills (2011)

Carbon finance, fuels & household

- 100+ fuel switching projects **involving wood**
- **3** major markets – VCS, Gold Standard, CDM, including fuel-switching
  - into sustainable wood use – plantations
  - away from unsustainable – e.g., over extraction of fw
  - more efficient use of fuel wood
- Household and small-industry projects



US (Clinton) commits $50M seed money