Assessing the Impact of Climate Mitigation Policies on Poverty in Developing Countries

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and Brent Sohngen (Ohio State)

Keynote Presentation at the African Agriculture GIS Week

Addis Ababa, Ethiopia, March 13, 2013

Outline of the talk

- Why am I here?
- Motivation: An overlooked dimension of poverty
- Key characteristics of GHG abatement policies
- Impacts on land use
- Impacts on the poor
- What we need from the African and CGIAR GIS communities
- How might GEOSHARE facilitate this?

Why am I here?

- Bulk of my work has focused on impacts of global policies at aggregated scale; what does this have to do with GIS analysis?
- As policy attention has shifted to impacts of global economic forces on environmental sustainability and poverty, multi-scale, local-global-local analyses are unavoidable
- GEOSHARE is an attempt to facilitate the necessary data exchange and dialogue across scales

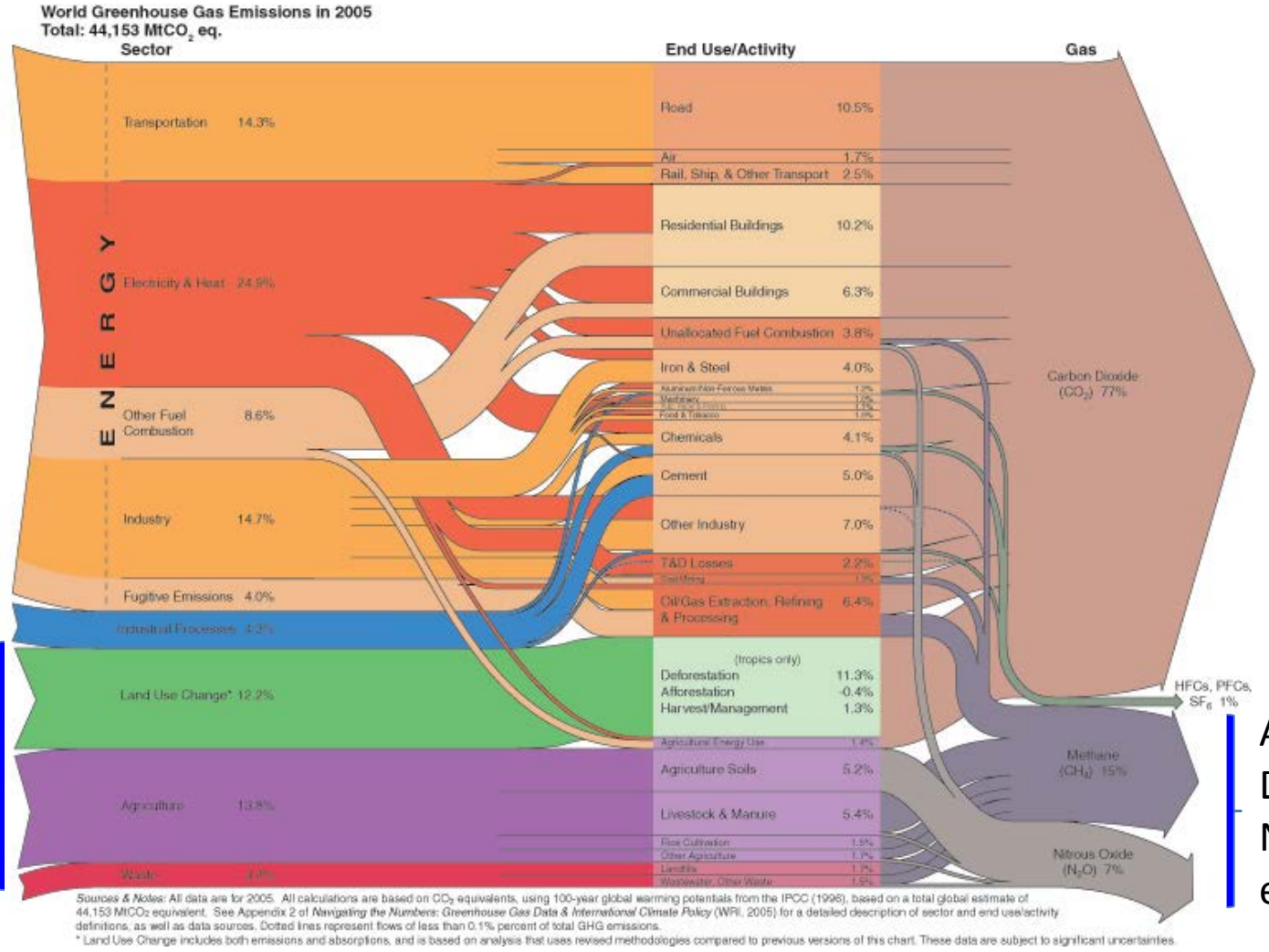
Motivation (1)

- Emerging body of literature on the ***impact of climate change*** on agriculture, food prices and the poor
- Lots of analysis of the ***aggregate economic impacts of climate mitigation*** policies; increasing attention to distributional impacts of policies in OECD economies
- ***Missing analysis of the impacts of mitigation policies on absolute poverty*** in developing countries
- *Hypothesis: In the near term (20 years)* ***the impact of climate mitigation policies on poverty*** *may be* ***more important than the impact of climate change*** *itself (Hertel and Rosch, 2010)*

Motivation (2)

- Logic behind this hypothesis:
  - Near term climate impacts likely modest
  - Land-based abatement (esp. forest carbon sequestration) is relatively cheap and already underway in developing countries
  - Land-based abatement uses lots of land, thereby raising cost of land for agriculture
  - Higher food prices affect the poor disproportionately
  - Farm incomes and wages are also affected
- Is it possible that *we have been ignoring a key driver of future well-being for the poor*?

Land-based emissions are important



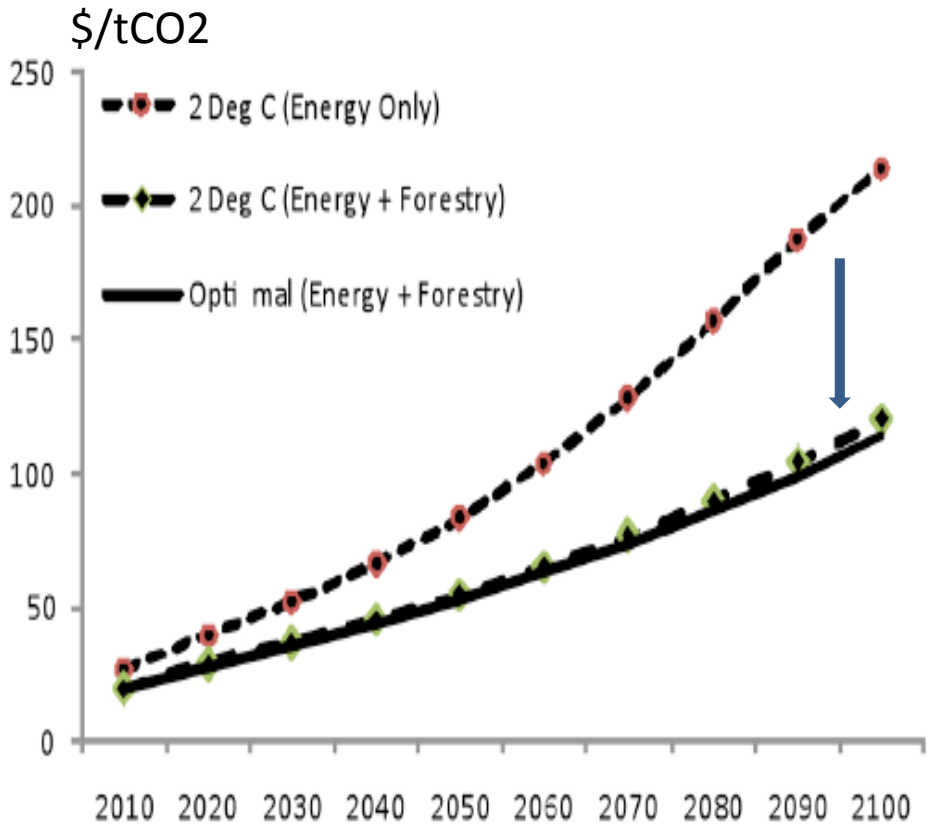
GHG emissions From land use change and agriculture

Agric Dominates Non-CO2 emissions

Source: Baumert et al., 2009

Land-based emissions can account for a large share of 'optimal' abatement in near term decades at modest carbon prices

- Golub et al. (2009): Land based mitigation could account for 50% of efficient abatement over the next 20 years, at $27tCO2eq
- Sohngen (2010):
  - 30% of optimal abatement over 21st century could come from forestry
  - Including forestry in abatement policy mix lowers the cost of energy-based abatement required to meet a given stabilization target (see figure)



Source: Sohngen, 2010

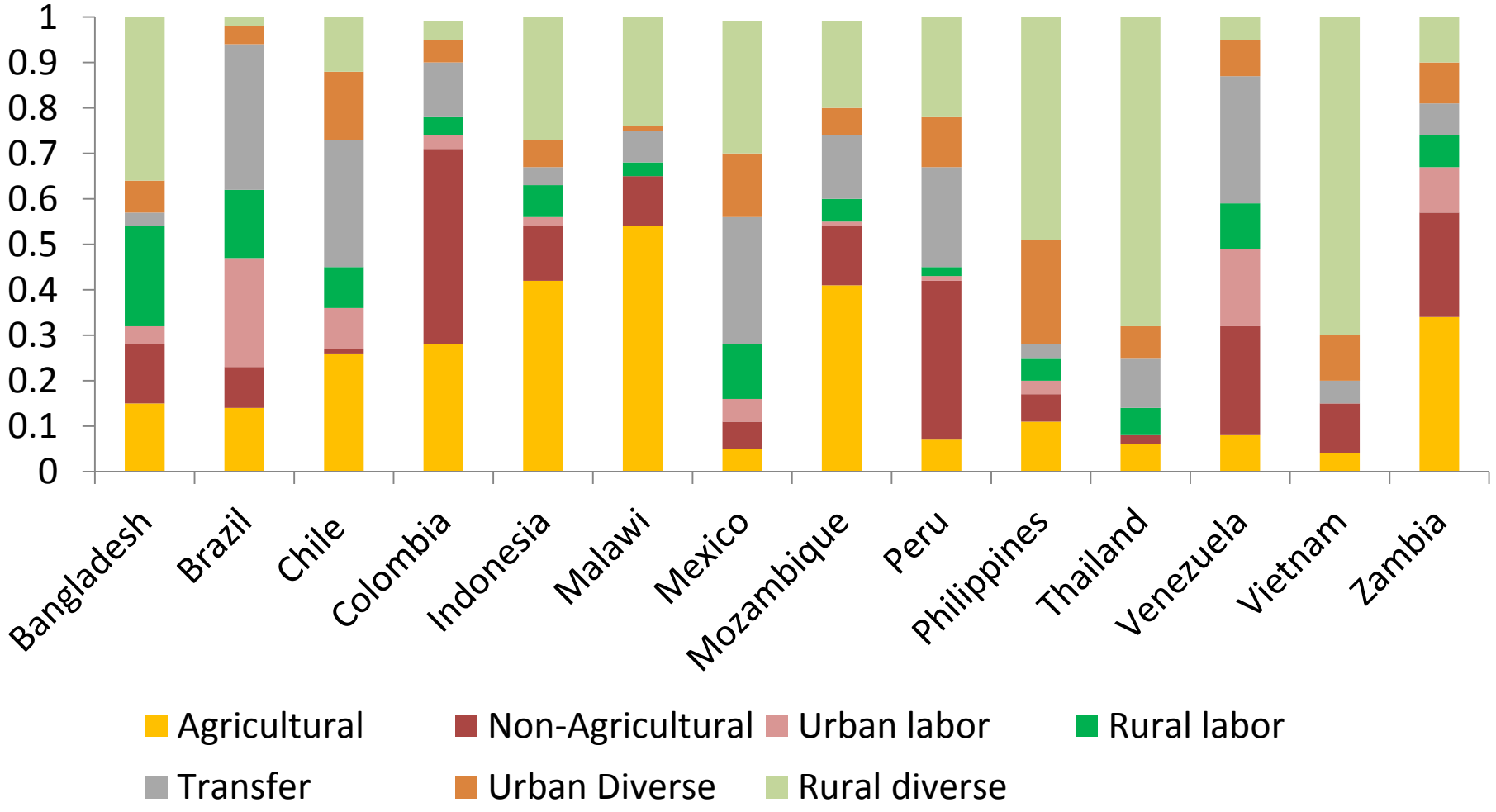
Methodology: GTAP-AEZ-GHG-POV

- Global CGE Model with explicit abatement options
- 35 sectors and 33 regions: aggregation of GTAP data base
  - Includes 14 developing countries from Africa, Asia, and Latin America for the poverty analysis
- Disaggregate land by Agro-Ecological Zone
- Full suite of GHG abatement options:
  - Non-C02 GHG emissions tied to drivers, e.g., livestock #'s, fert use
  - CO2 GHG emissions tied to fossil fuel use
  - Options for forest carbon sequestration from:
    - Reduced deforestation
    - Managing existing forests
    - Planting more forests
- Poverty module based on hhld surveys for these 14 countries:
  - Who are the poor?
  - Where do they live?
  - How do they earn their income?
  - How do they spend their income?

Who are the poor?

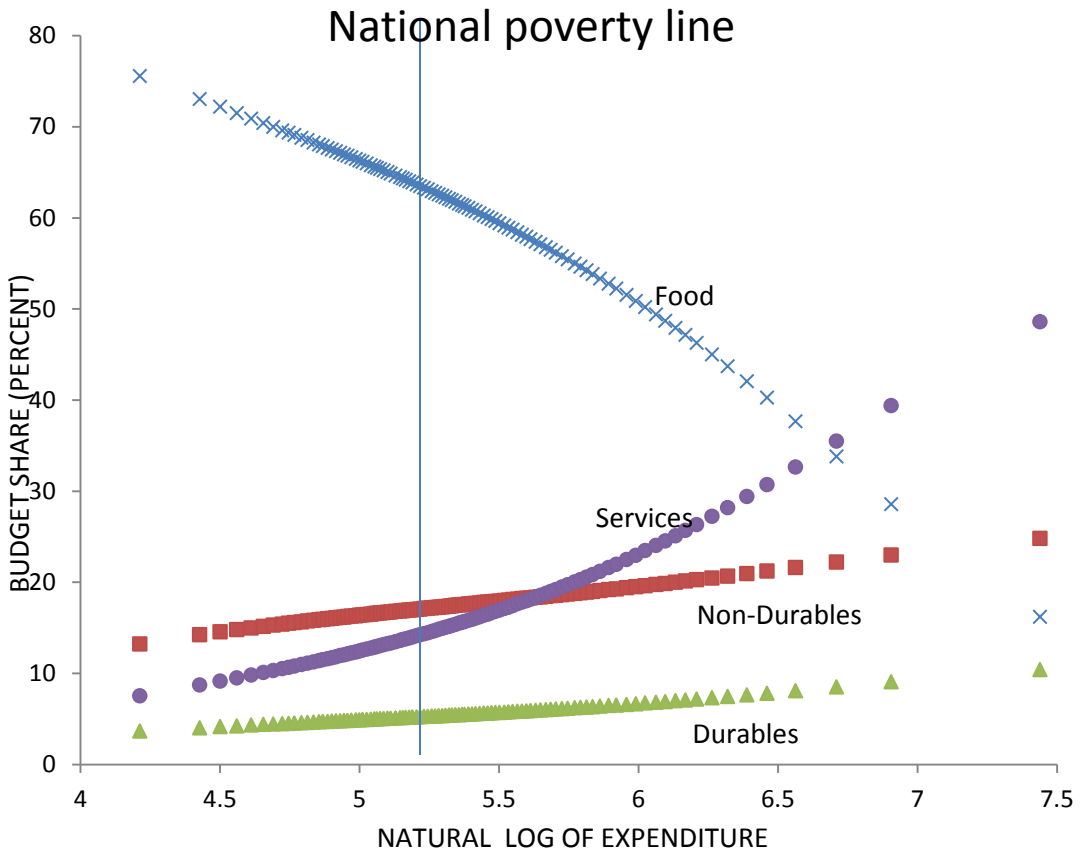
- We delved into household surveys for individual countries (Hertel et al, 2007)
- Identify those living at or below $1/day
- Classify according to primary source (95% or more) of income:
  - Self employment (agr/nonagr)
  - Wage labor (rural/urban)
  - Transfers
  - Diversified (rural/urban)
- Impute income sources for self-employed

How do they earn their living?



Source: Hertel et al., 2010

How do the poor spend their income?



Estimated Spending patterns in Bangladesh

Source: Verma et al., 2011

How are the poor likely to be affected by climate mitigation policies?

- Can result in large transfer of income developing world – as much as 4% (Brazil) – 5% (Zambia) of GDP
- However, not all will benefit equally…..
- More intense competition for land raises land and food prices; this is bad for low income consumers with large food budget share
- Those who have some claim on rural land – either private or communal ownership -- may gain
- Low income urban wage labor households most likely to lose from policy: food prices rise, but no offsetting rise in income

Scenario A: Annex I countries 'go it alone' with a 27$/t$CO_2$eq tax

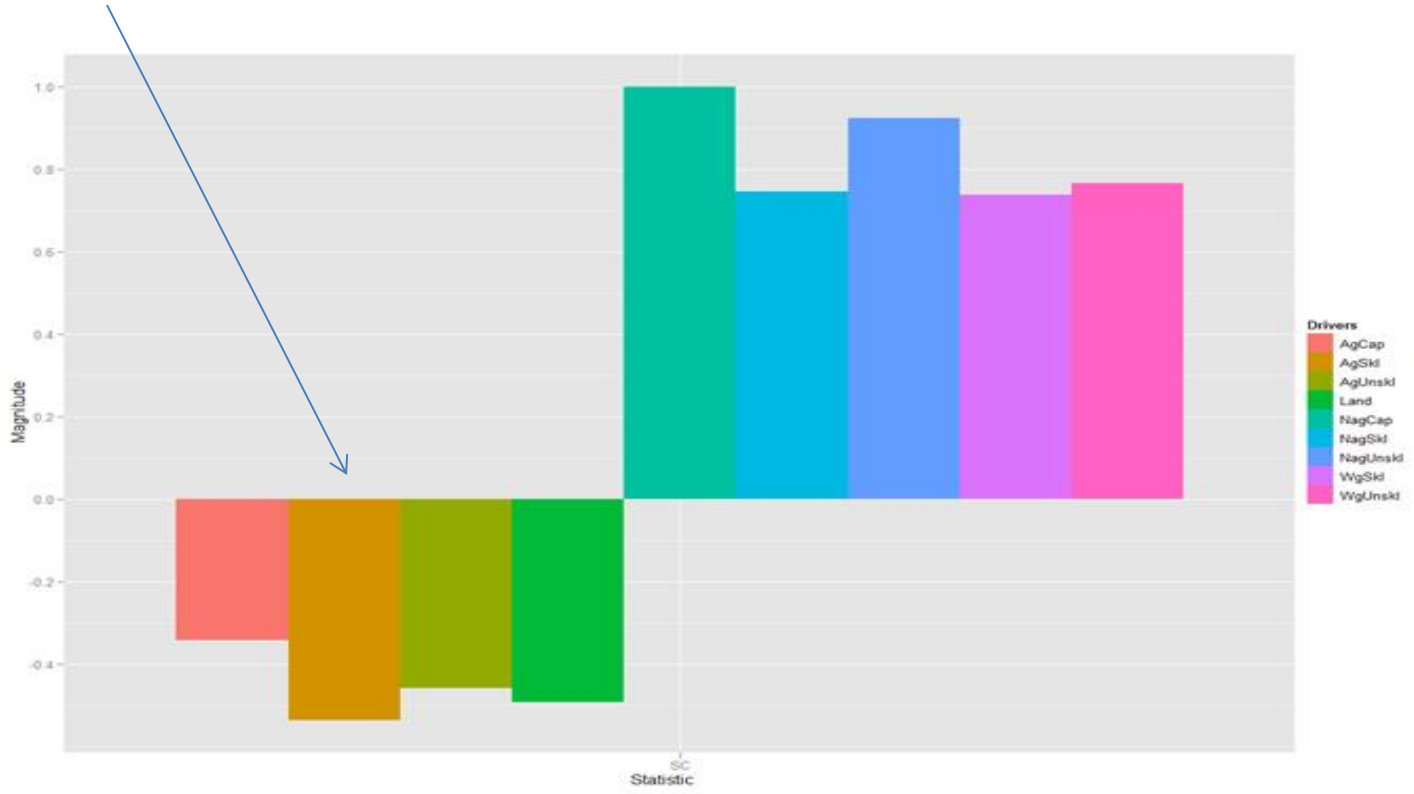
Scenario	Forest carbon seq. incentive		Carbon tax	
	Annex I	Non-Annex I	Annex I	Non-Annex 1
A	✓	n.a.	✓	n.a.

Annex I region includes: USA, Canada, Europe, Russia, Japan, Oceania

Source: Golub et al., 2012

Annex I CO2 tax causes industry to contract/agr expands; opposite in developing countries so *real returns to agr in poor countries fall*

CO2 tax lowers returns to agr in developing countries

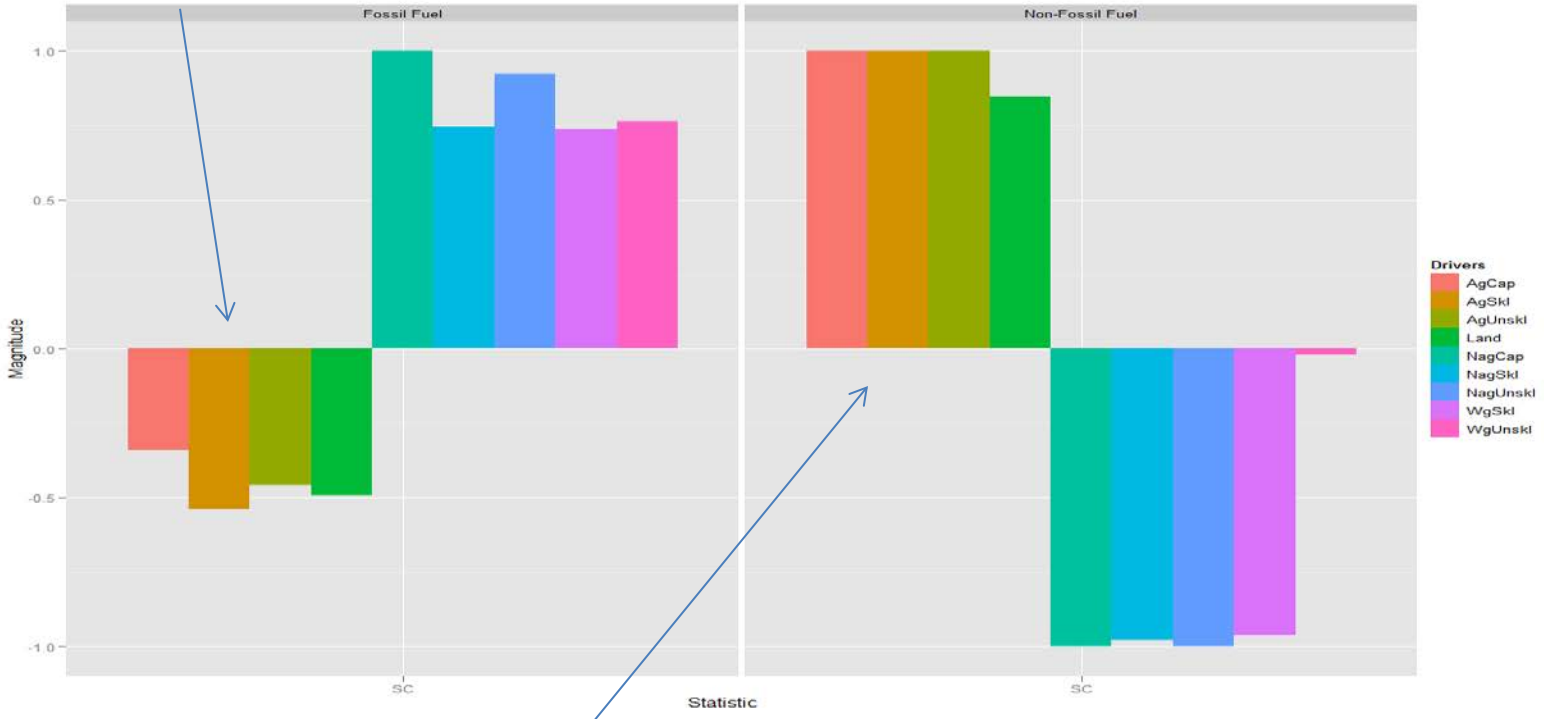


Sign consistency = Avg/avg absolute value of returns to factors of production
Ranges between -1 (always falls) and +1 (always rises)

Annex I non-CO2 tax causes agr to contract/industry expands; opposite in developing countries, so *real returns to agr in poor countries rise*

Sign consistency(SC) = Avg/avg absolute value of returns to factors of production
Ranges between -1 (always falls) and +1 (always rises)

CO2 tax lowers returns to agr in developing countries

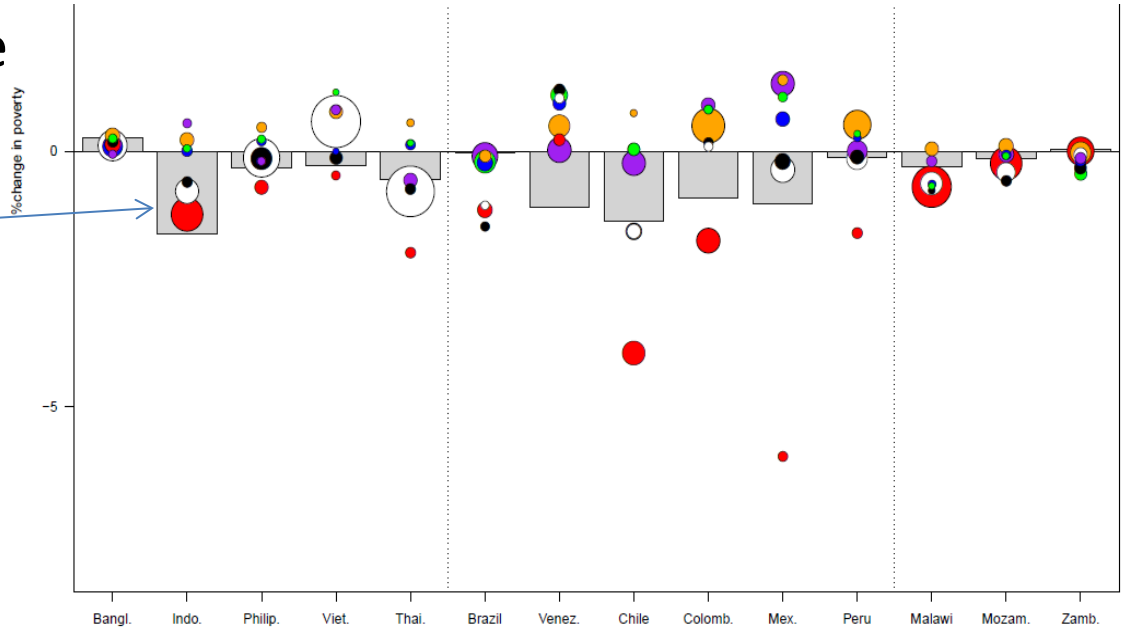


Non-CO2 tax boosts real returns to agr in developing countries

The overall effect of Annex I policies taken alone tends to be beneficial to the poor

- Annex I CO2 tax benefits industry and urban households, while non-CO2 tax benefits rural households and agriculture
- Taken together ***poverty declines in 9 of the 14 developing countries***

Grey bars = total poverty impact
Circle area = proportion of poor in that stratum
Red circles = agriculture self-employed
Orange = non-agriculture self-employed
Green = urban labor
Blue = Rural labor
Purple = Transfer dependent
Black = Urban diversified
White = rural diversified

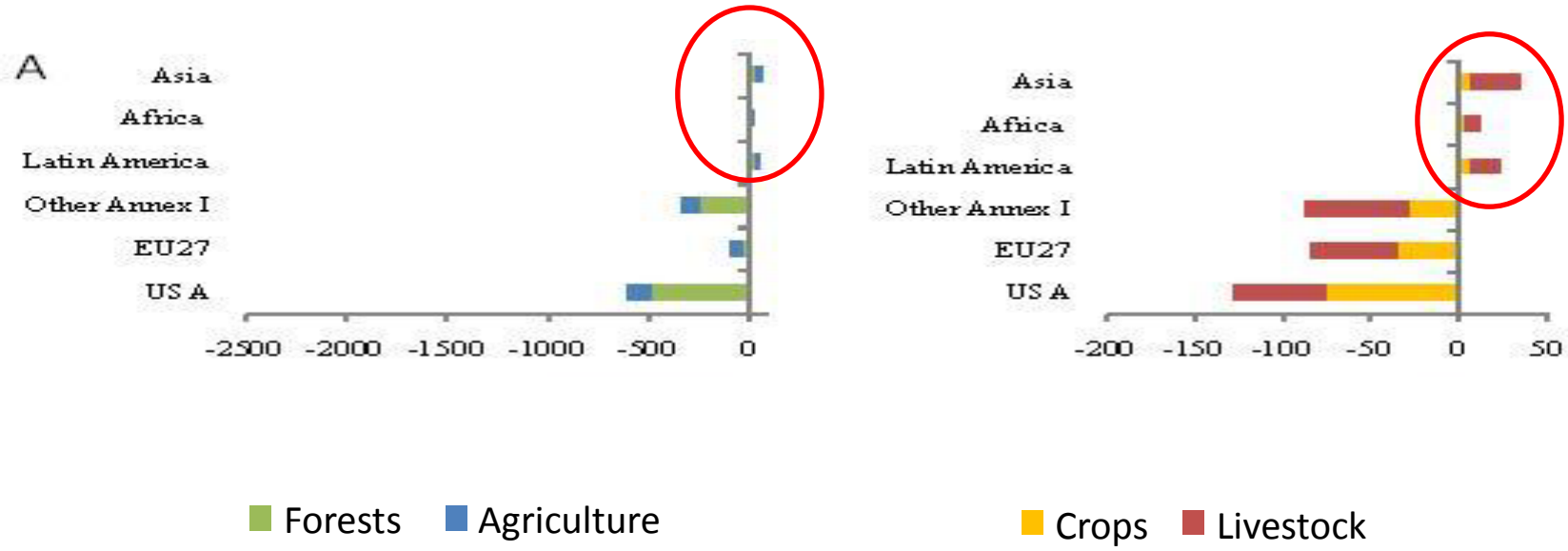


Source: Hussein et al., 2013

The problem with Annex I going it alone is leakage

Forest and Agr combined leakage = 16%

Agriculture leakage = 25%
Livestock leakage = 35%



Annex I agriculture loses competitiveness and production & GHGs rise in developing countries

Source: Golub et al., 2012

Scenario B adds carbon forest sequestration incentives in developing countries, paid for by Annex I (minus Russia)

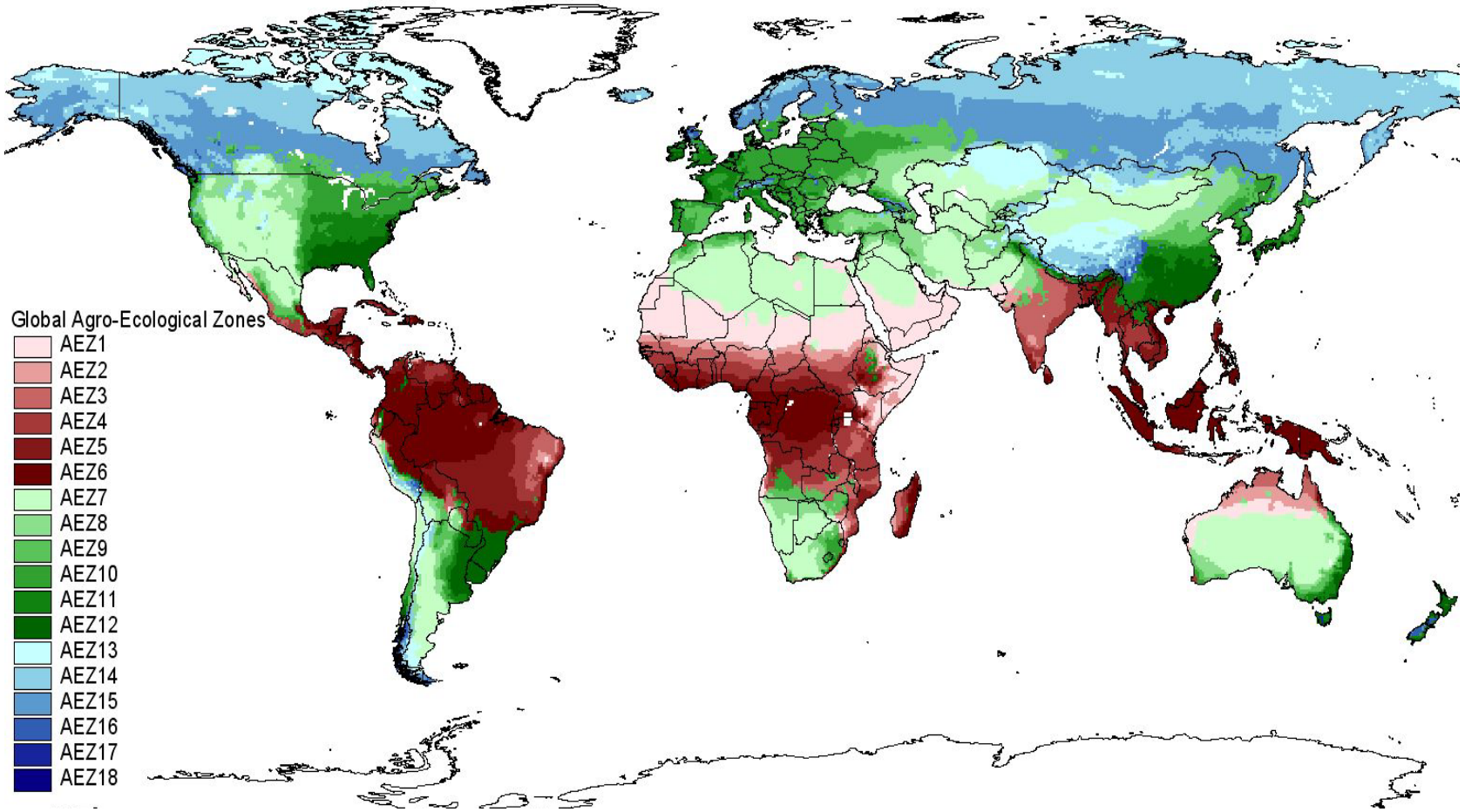
Scenario	Forest carbon seq. incentive		Carbon tax	
	Annex I	Non-Annex I	Annex I	Non-Annex 1
A	✓	n.a.	✓	n.a.
B	✓	✓	✓	n.a.

Difference is carbon forest sequestration in developing countries

Source: Golub et al., 2012

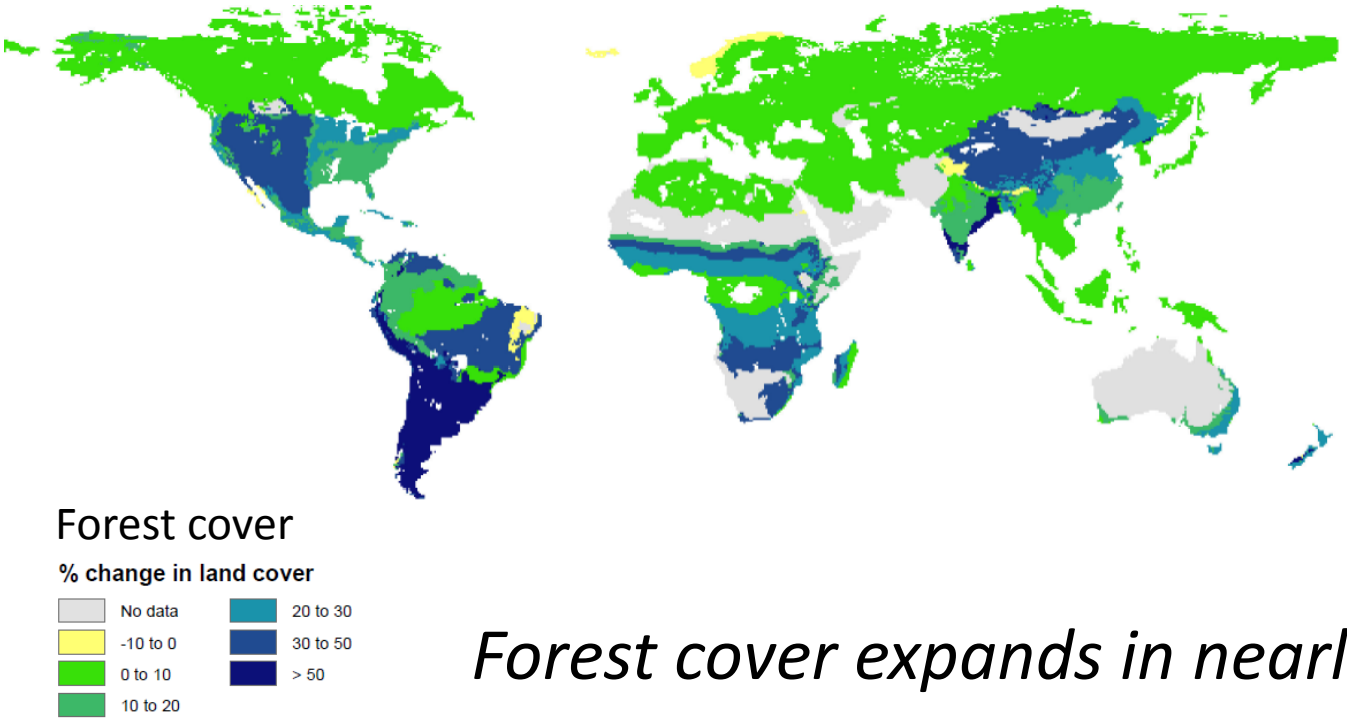
Understanding Impact of Carbon Forest Sequestration Subsidy requires understanding competition for land

Global Distribution of AEZs



Source: Lee *et al*. 2005

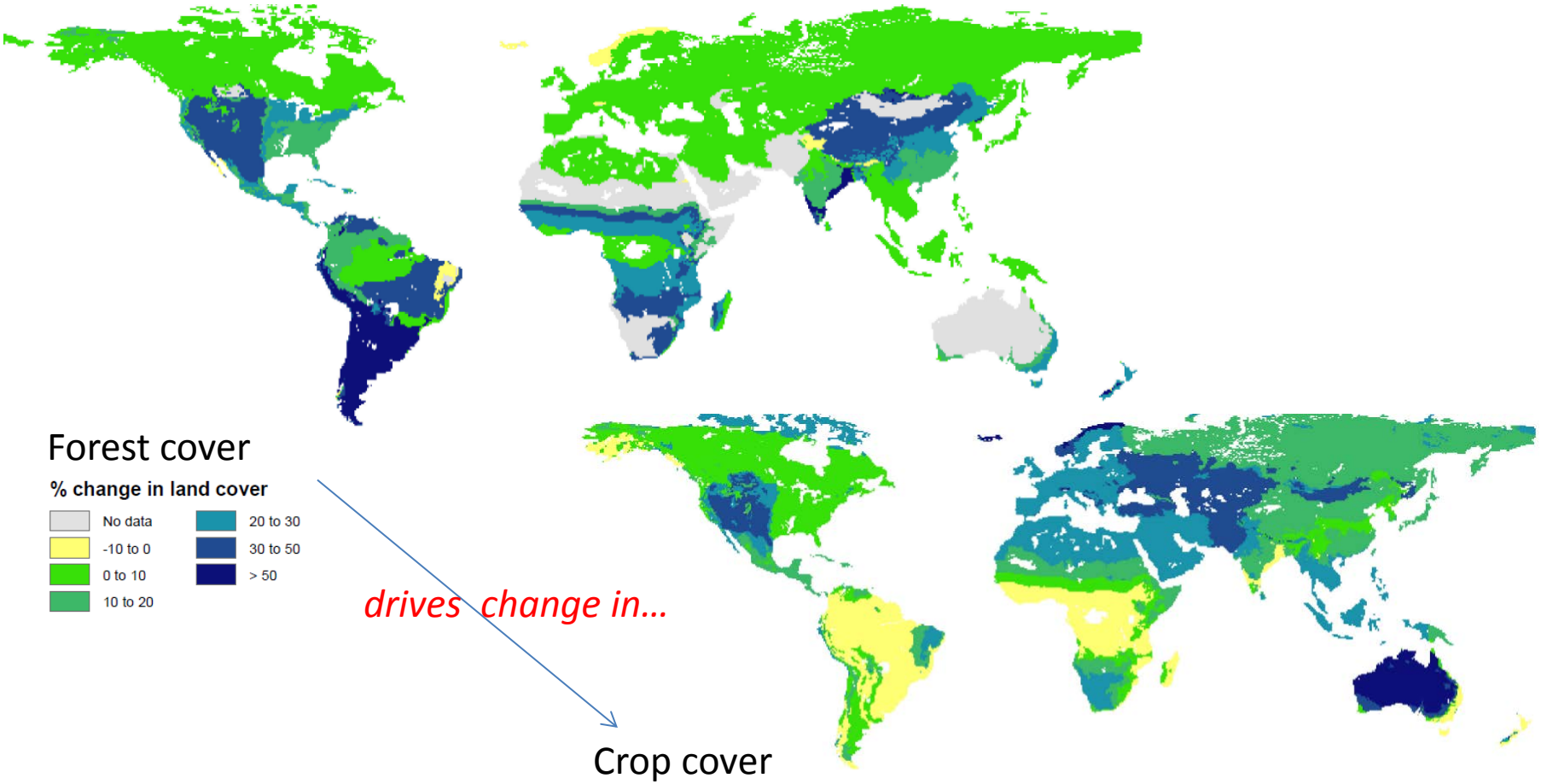
Abatement scenario B has a big impact on the pattern of forest land cover



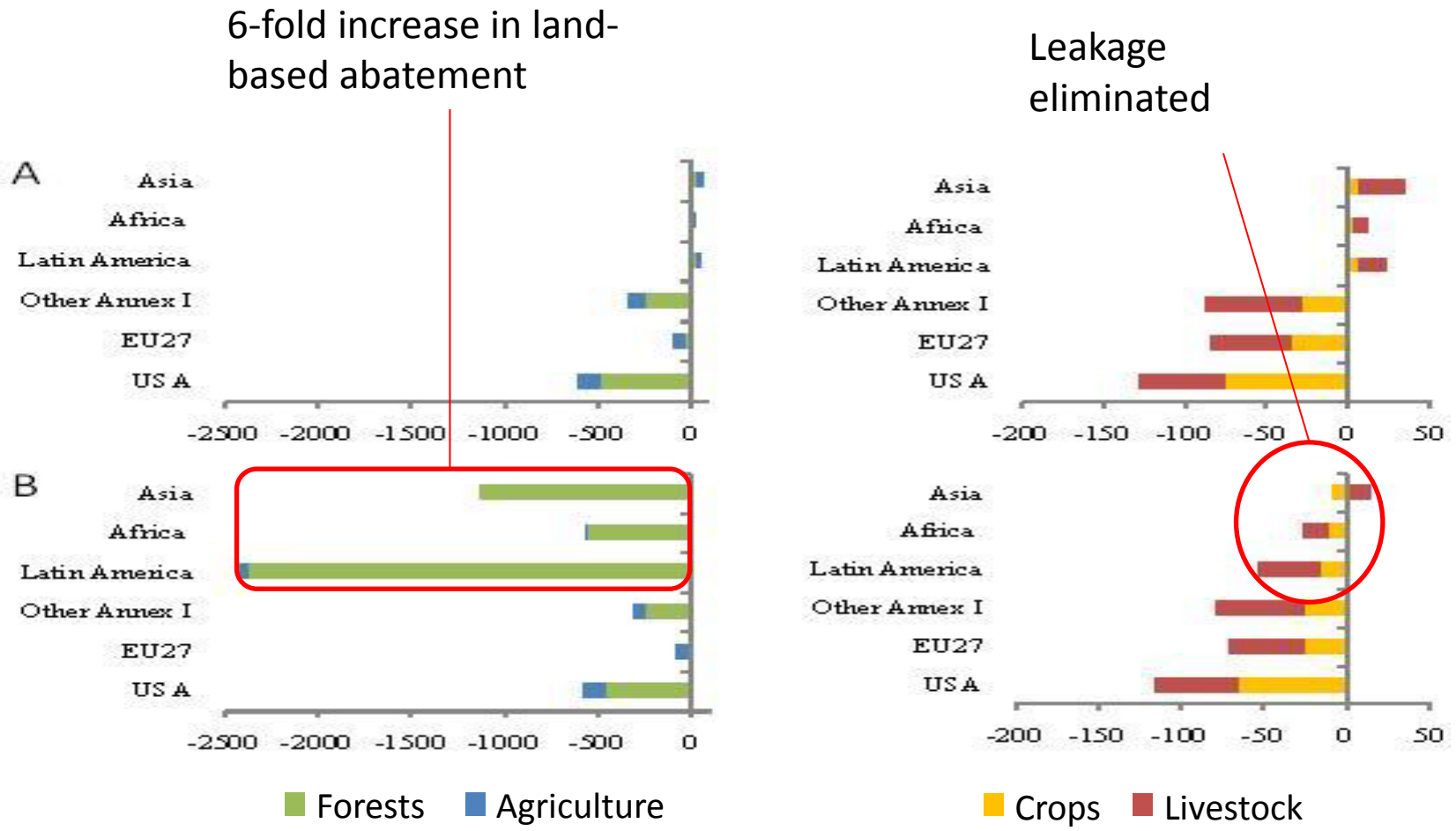
Forest cover expands in nearly all regions

Source: Golub et al., 2012

Abatement scenario B has a big impact on the pattern of crop land cover



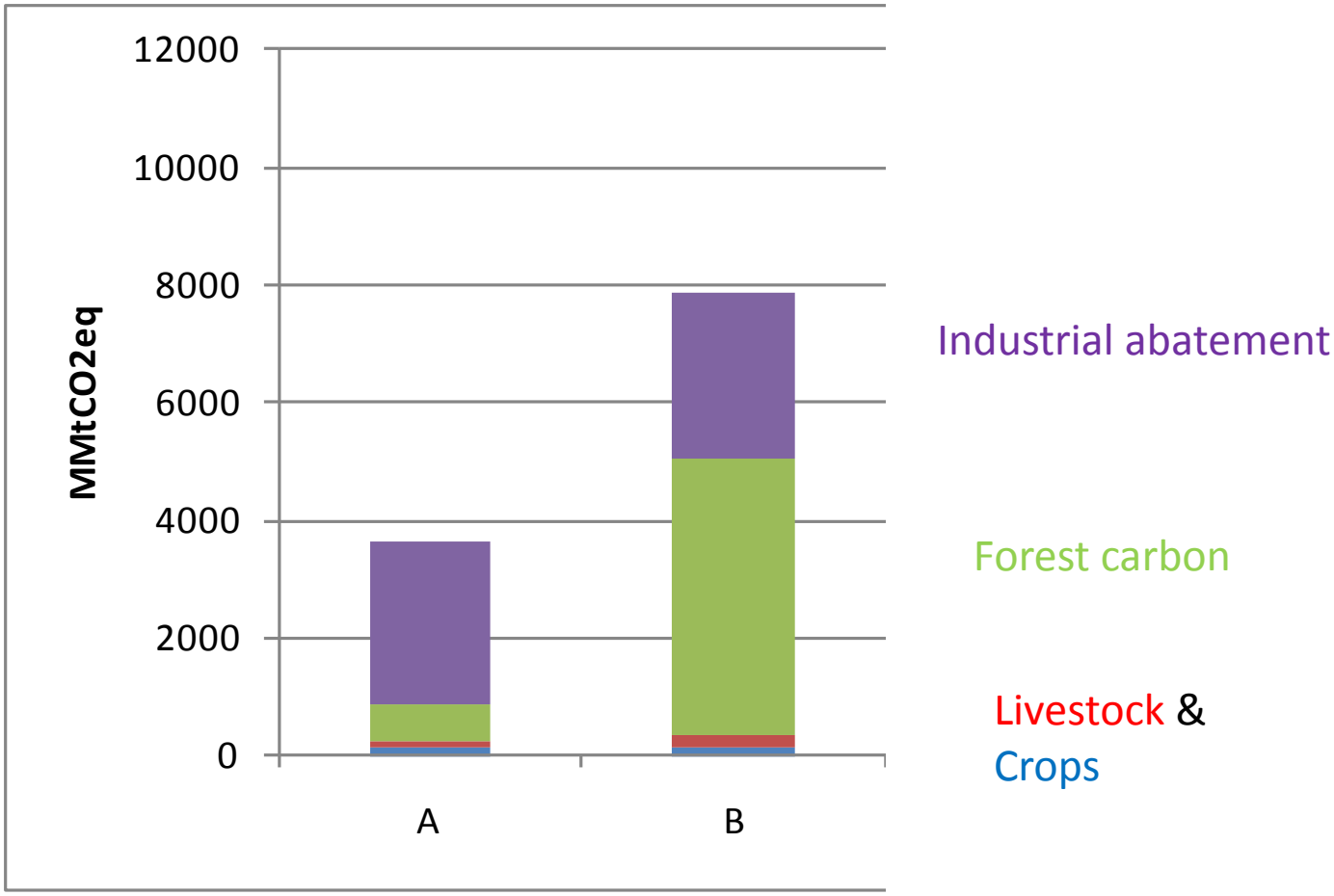
Source: Golub et al., 2012



Adding Forest Carbon Sequestration also curbs leakage

Source: Golub et al., 2012

Adding developing country forest carbon sequestration doubles global abatement



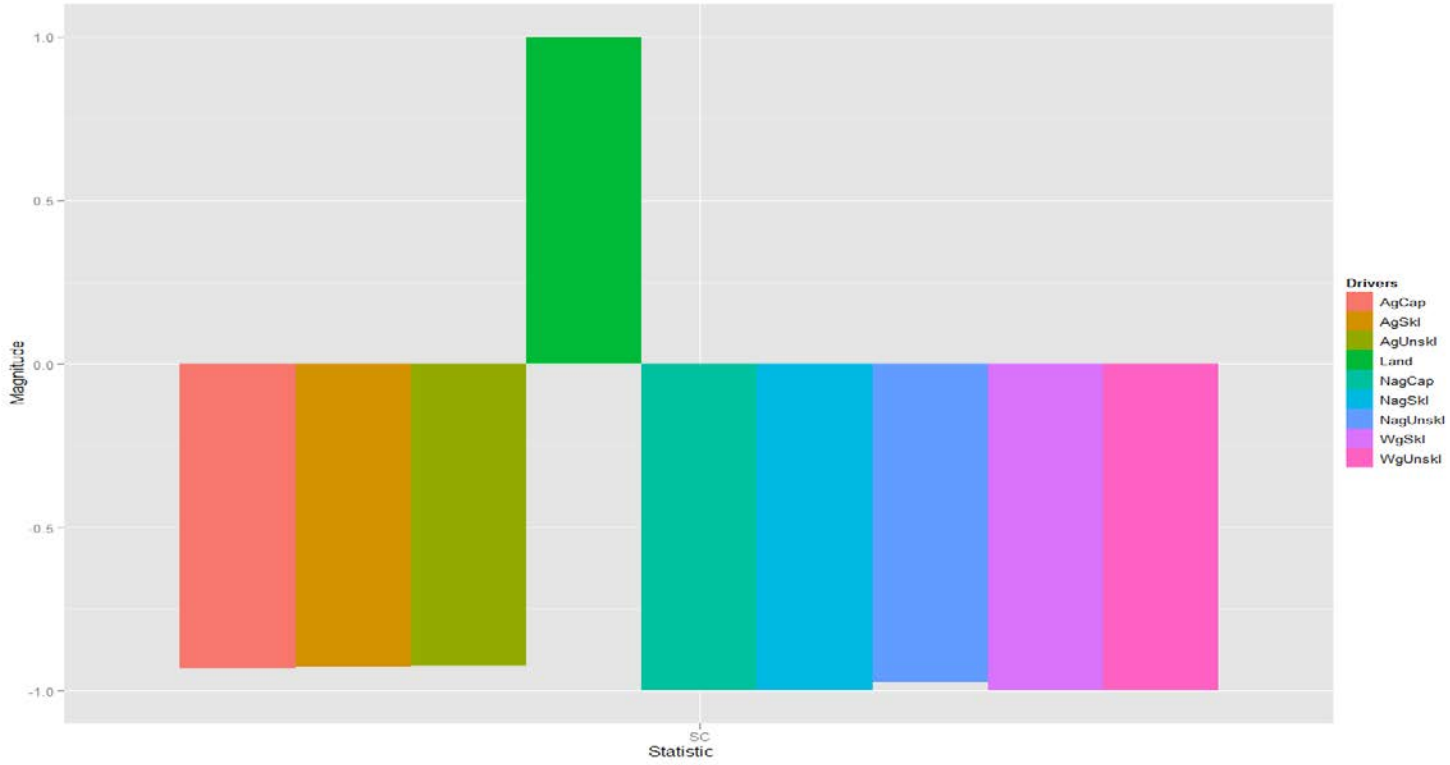
Source: Golub et al., 2012

In sum, there are good reasons to add forest carbon sequestration in developing countries

- Curbs agricultural leakage
- Boosts overall GHG emissions reduction
- Reduces cost of climate stabilization
- Income transfer to developing countries
- And its already happening!
- But who benefits? What are the likely impacts on poverty?

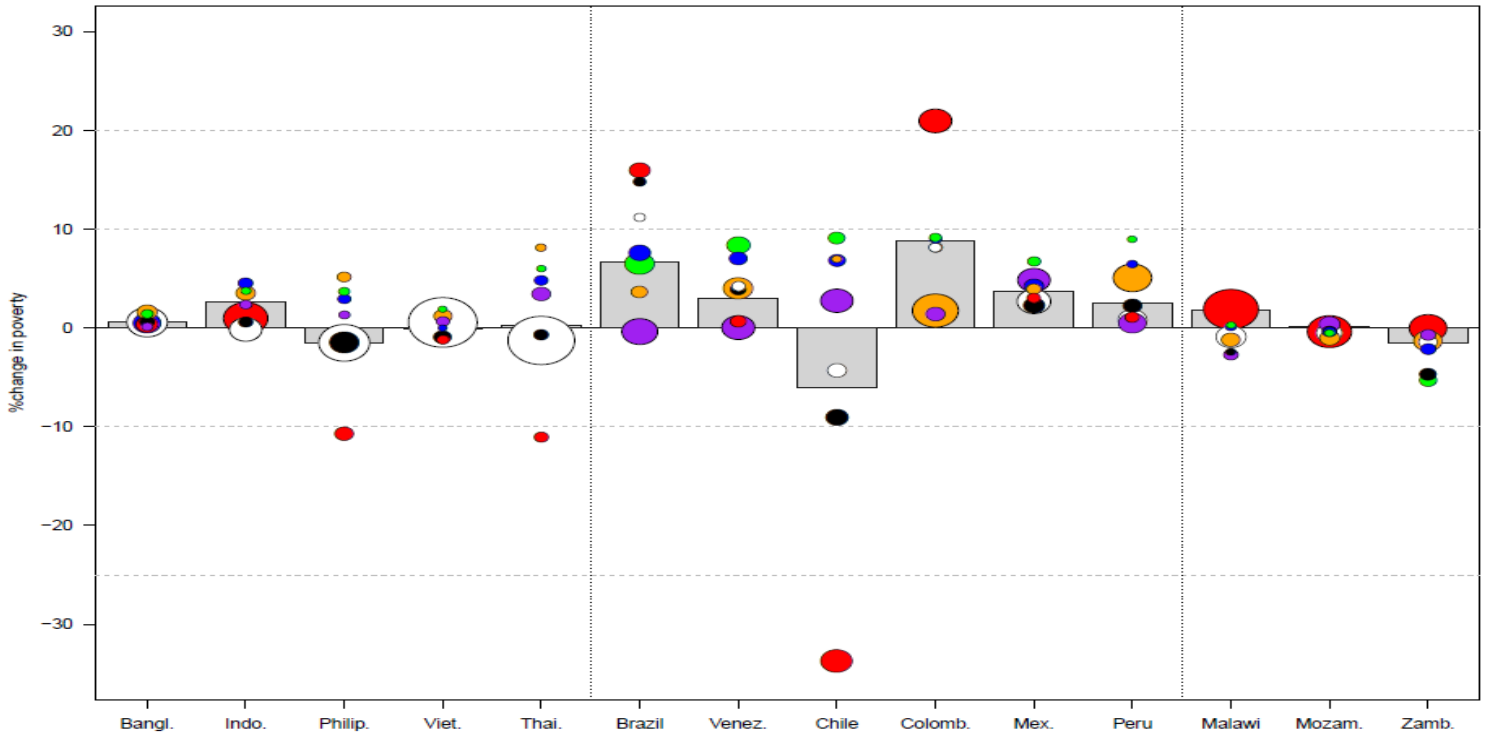
In Scenario B benefits flow almost entirely to landowners

Sign consistency (SC)= Avg/avg absolute value of returns to factors of production
Ranges between -1 (always falls) and +1 (always rises)



Source: Hussein et al., 2013

Poverty impacts of Scenario B
(Annex I policies PLUS global forest carbon sequestration)



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Summary:

- poverty rises in 8 of 14 countries
- poverty reduction in Chile is driven by private agr land ownership
- contrasts sharply with Brazil and Colombia
- ignores communal land

Conclusions:
What we need from the GIS community

- Climate policies can have large and varied impacts on poverty
- Poverty impacts are dominated by forest carbon sequestration subsidies in developing countries
- Poverty friendly policies must allow poor to share in benefits from carbon payments on communal lands
- Effects are complex, *accurate assessment requires much better data* on:
  - Land cover and land use
  - Distribution of poor by AEZ
  - Spatial distribution of private and communal lands
- GEOSHARE seeks to facilitate communication of these needs across scales

GEOSHARE Roots (1)

Global Land Use
Navin Ramankutt
McGill U.

Global Water Use in Agriculture
Stefan Siebert, U. Bonn

Geoshare began with the idea of building a new global data base for land and water which was internally consistent in its treatment of area and yields for rainfed, irrigated and total crop production.

Think of a merger of AgroMaps, M-3, SPAM, and MIRCA for benchmark years 2005, 2010, 2015, ….

GEOSHARE Roots (2)

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Global Climate
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Stanford U.

GEOSHARE
Economic Analysis ar
Project Coordination
Thomas Hertel and
Nelson Villoria
Purdue University

Agriculture, Environment, & Poverty in Asia
Andrew Nelson, IRRI

Agriculture, Environment, & Poverty in Latin America
Glenn Hyman, CIAT

Agriculture, Environment, & Poverty in Africa
Stanley Wood, IFPRI

Purdue's role in GEOSHARE is to play a coordinating role:

- **drawing heavily on GTAP experience**
- **exploiting recent developments in HubZero architecture**
- **make the link to global economic analysis**

Global and regional nodes are crucial to incorporate local knowledge into global data architecture

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GEOSHARE Pilot Project Funded by DFID-DEFRA-USDA:

- **Engaging with regional policy makers and stakeholders in countries in Africa (6) and South Asia (2)**
- **Developing interoperable data bases on land use and poverty**
- **Undertaking case studies on agriculture and poverty**
- **Demonstrating capability of HUBZero cyber infrastructure to facilitate interactions**

GEOSHARE features a *scalable structure* which can be readily expanded

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Glenn Hyman, CIAT

Agriculture, Environment, & Poverty in Africa
IFPRI

Global Livestock
ILRI, FAO?

Land Tenure
Klaus Deininger, World Bank

Status and next steps with GEOSHARE

- Currently in proof-of-concept phase with funding from DFID, DEFRA, USDA,CCAFS and Purdue involving
  - 2 global nodes (Bonn, McGill)
  - 2 regional nodes (IFPRI, IRRI)
- Engaging with stakeholders in several countries in Africa and South Asia
- Developing interoperable data bases on land cover, land use and poverty
- Undertaking 2 case studies on agriculture and poverty
- Developing capability of HUBZero cyber infrastructure to facilitate interactions (Nelson will present this)

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