Climate change mitigation policies and the poor: Is land tenure the missing link?

Prepared by Thomas W. Hertel

and Zekarias Hussein

Purdue University

Based on collaborations with Alla Golub (Purdue), Ben Henderson and Pierre Gerber (FAO), Steven Rose (EPRI)

and Brent Sohngen (Ohio State)

Presentation to the 2013 Conference on Land and Poverty

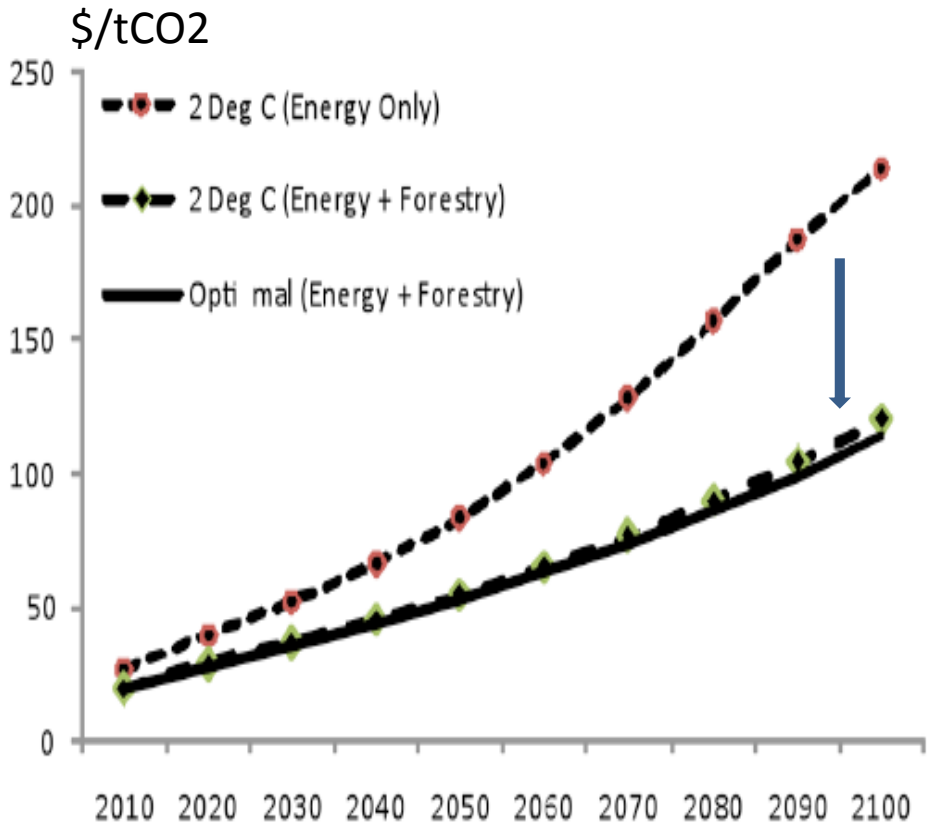
The World Bank, Washington, D.C., April 10, 2013

Motivation (1)

- Rapidly growing 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
- ***Missing analysis of the impacts of mitigation policies on absolute poverty*** in developing countries
- *Hypotheses:*
  - *In the next 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)*
  - ***Whether or not such policies are poverty friendly will depend critically on land tenure and titling***

Special attention to land-based emissions which account for a large share of 'optimal' abatement in near term decades

- 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

Motivation (2)

- Logic behind our hypotheses:
  - Near term climate impacts likely to be 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
  - ***Poverty impacts hinge on land ownership/tenure***
- Is it possible that *we have been ignoring a key driver of future well-being for the poor*?

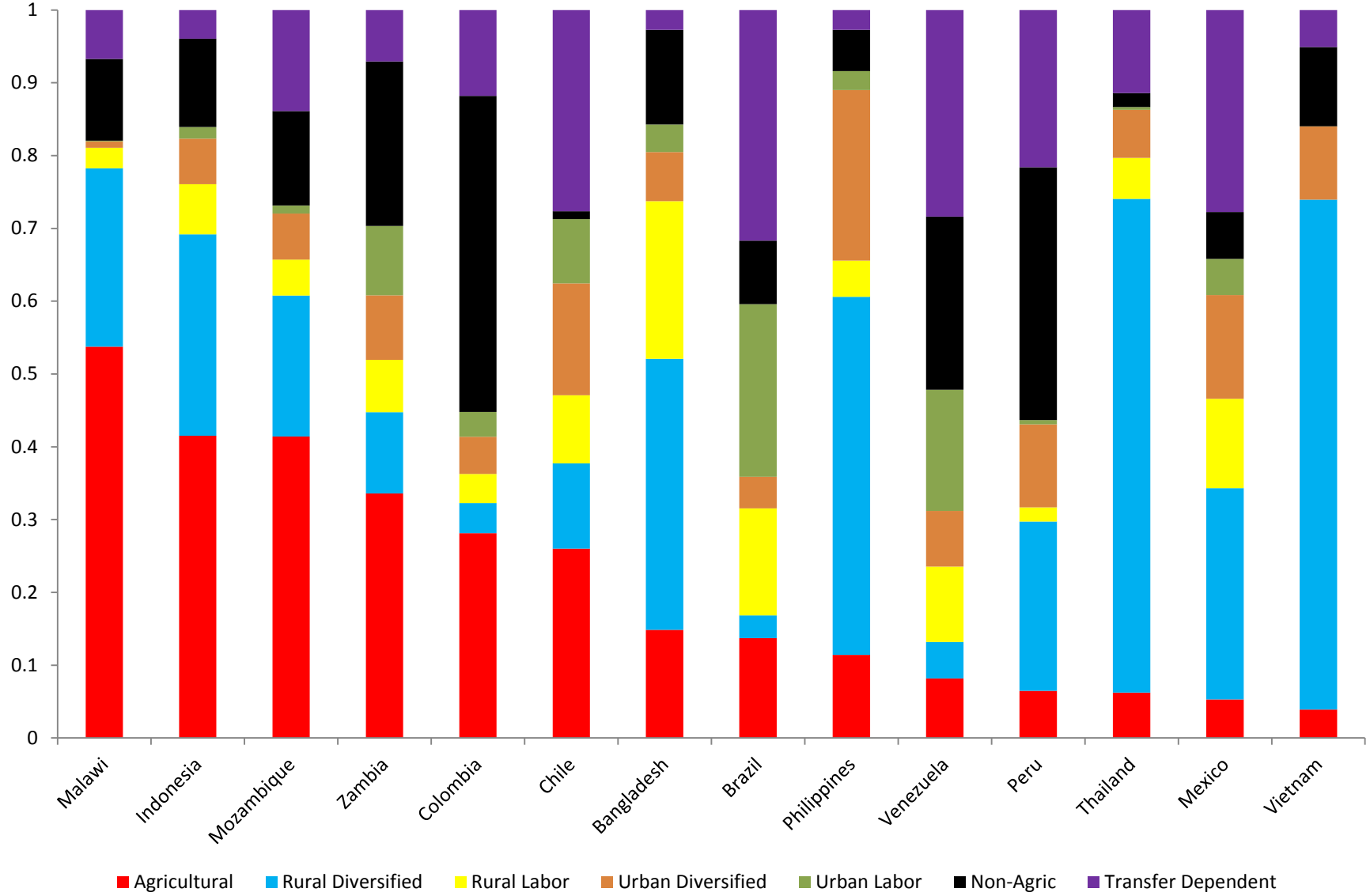
Taking a first cut at the problem using the GTAP-AEZ-GHG-POV model

- 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 (Lee et al.)
- Full suite of GHG abatement options (Golub et al.):
  - 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 14 countries (Hertel et al.)
  - 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, 2009)
- 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: returns to land are a residual claimant on income

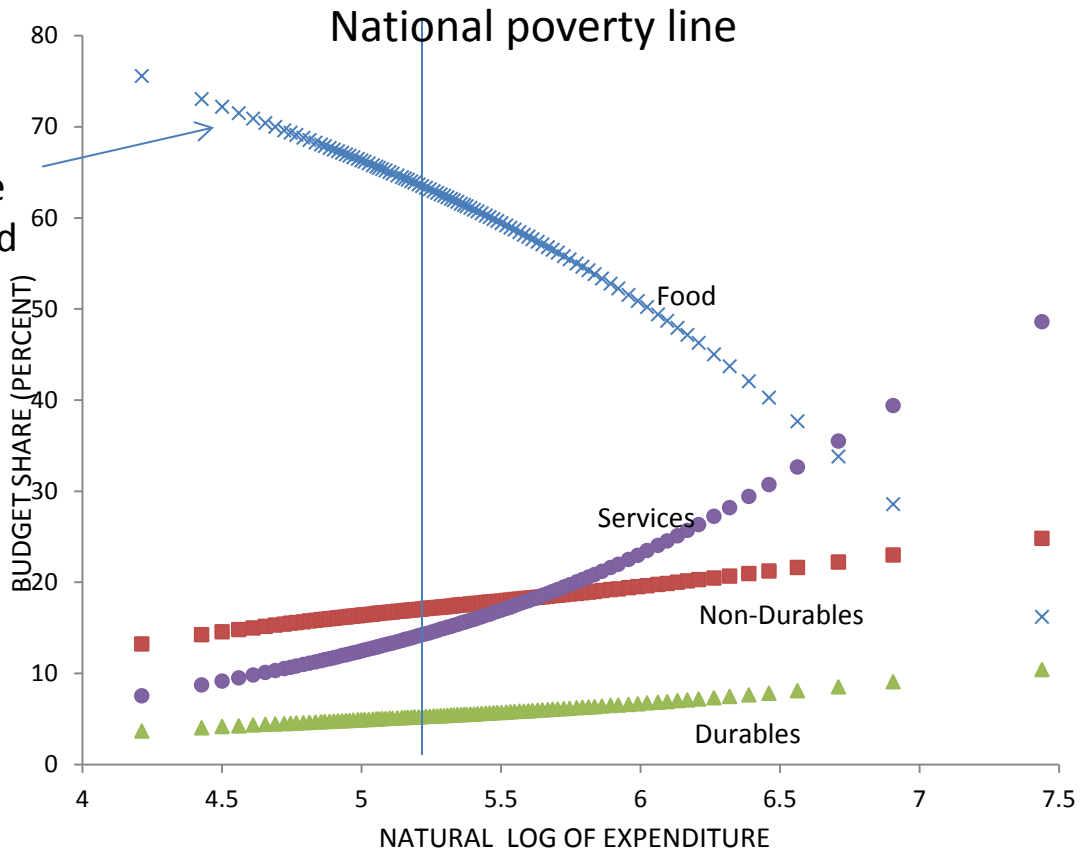
How do the poor earn their living?



Source: Hertel et al., 2011

How do the poor spend their income?

The poorest spend a disproportionate share of their income on food



Estimated Spending patterns in Bangladesh

Source: Verma et al., 2011

Two broad climate policy scenarios

- Scenario A: Annex I countries 'go it alone':
  - Fossil fuels
  - Inclusion of non-CO2 (Agric) and forest carbon
- Scenario B: Annex I plus forest carbon sequestration in developing world

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.

Carbon tax/forest carbon incentive payment = $27/tCO2e

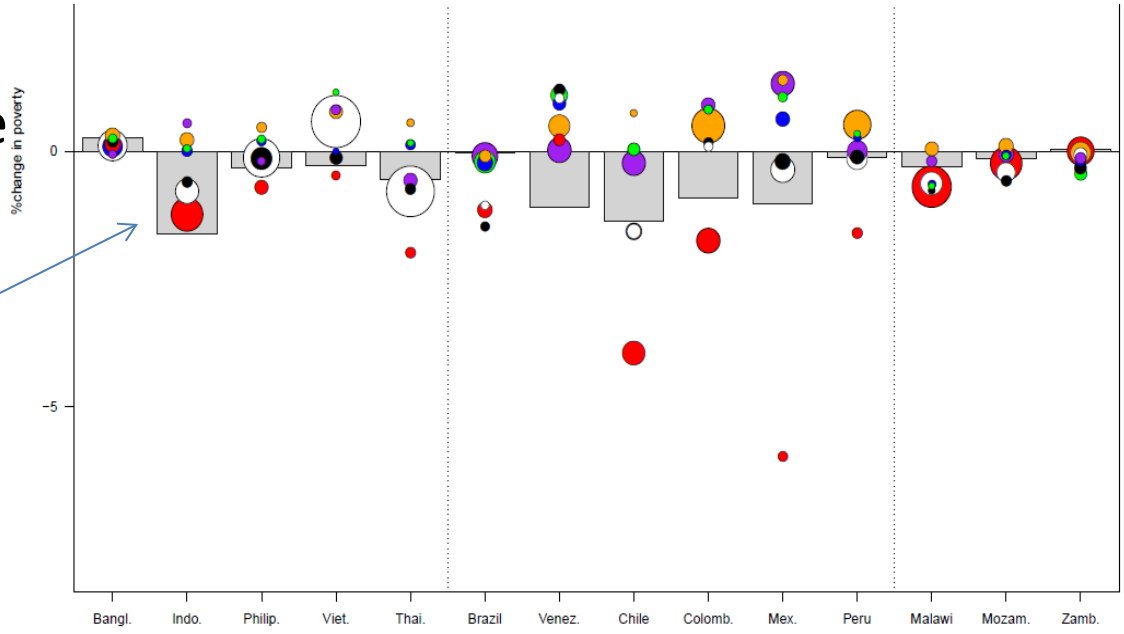
Annex I region includes: USA, Canada, Europe, Russia, Japan, Oceania

Source: Golub et al., 2012

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

- Annex I CO2 tax benefits industry and urban households, while non-CO2 tax and forest carbon incentives benefit 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

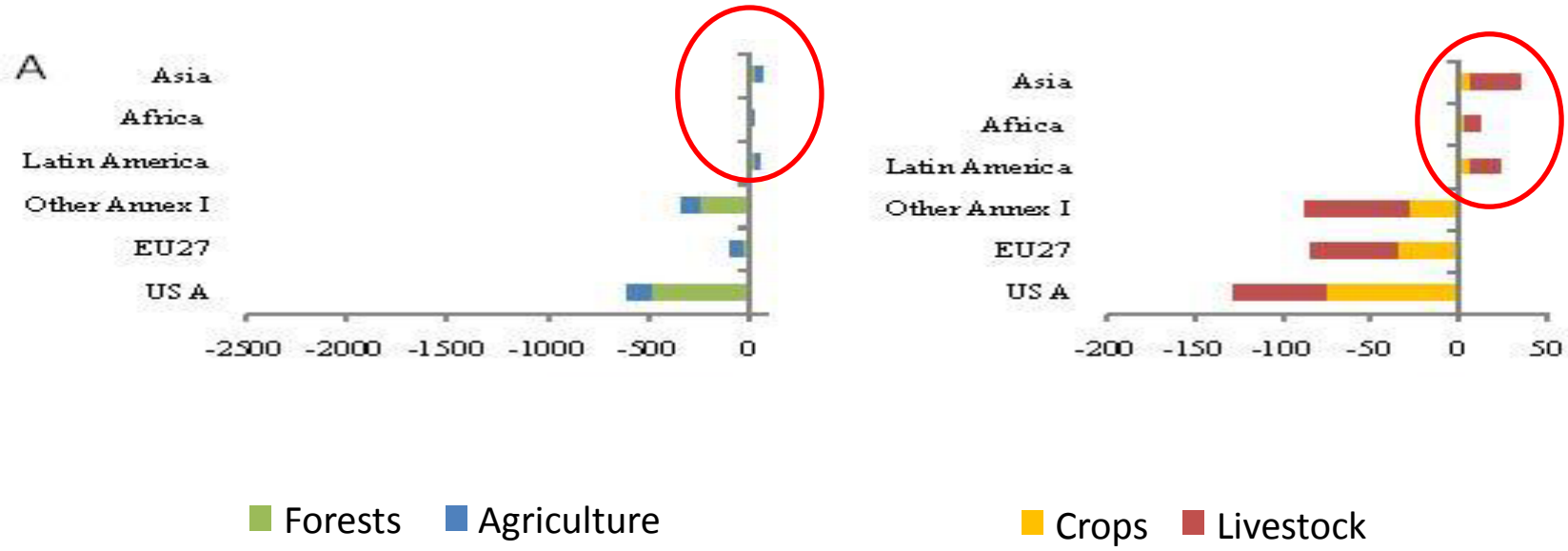


Source: Hussein et al., 2013

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

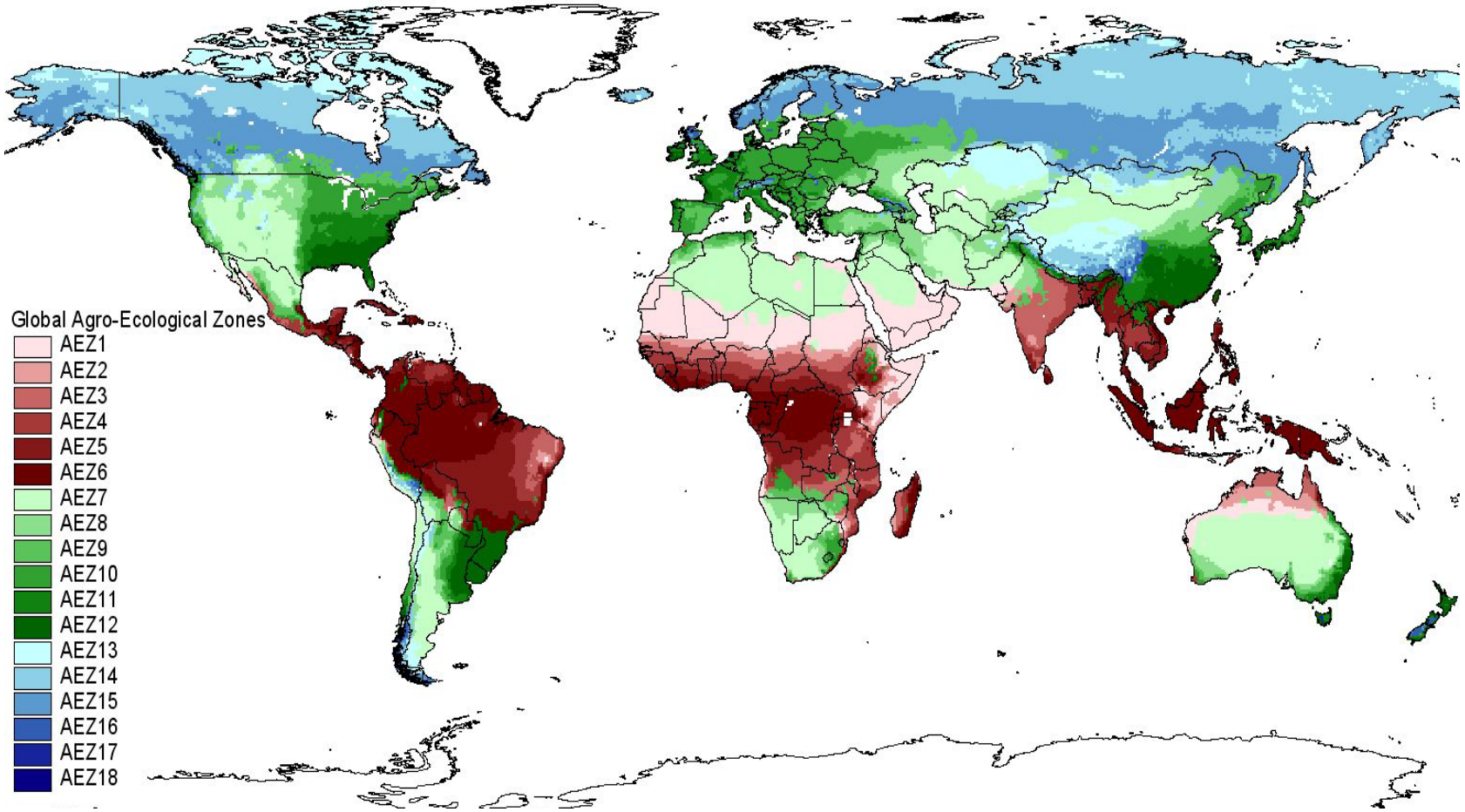
Source: Golub et al., 2012

How are the poor likely to be affected by forest sequestration incentives?

- 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; bad for poor consumers -- high food budget share
- Those who have some claim on rural land – either private or communal ownership -- may gain:
  - Directly through program participation
  - Indirectly through appreciation of land values
- Low income urban wage labor households likely to lose: food prices rise, but no offsetting rise in income
- Overall poverty impact depends on distribution of poor

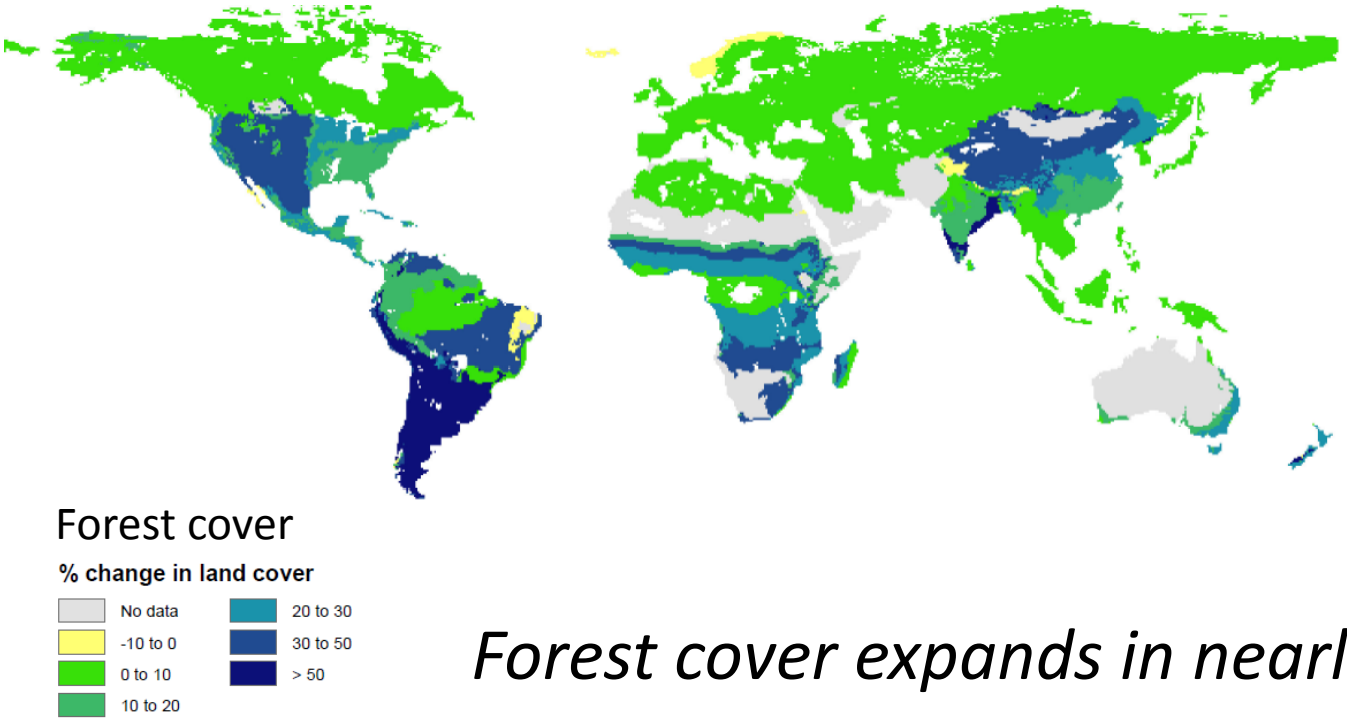
Understanding Impact of Carbon Forest Sequestration Subsidy requires understanding competition for land

Global Distribution of Agro-Ecological Zones



Source: Lee *et al*. 2005

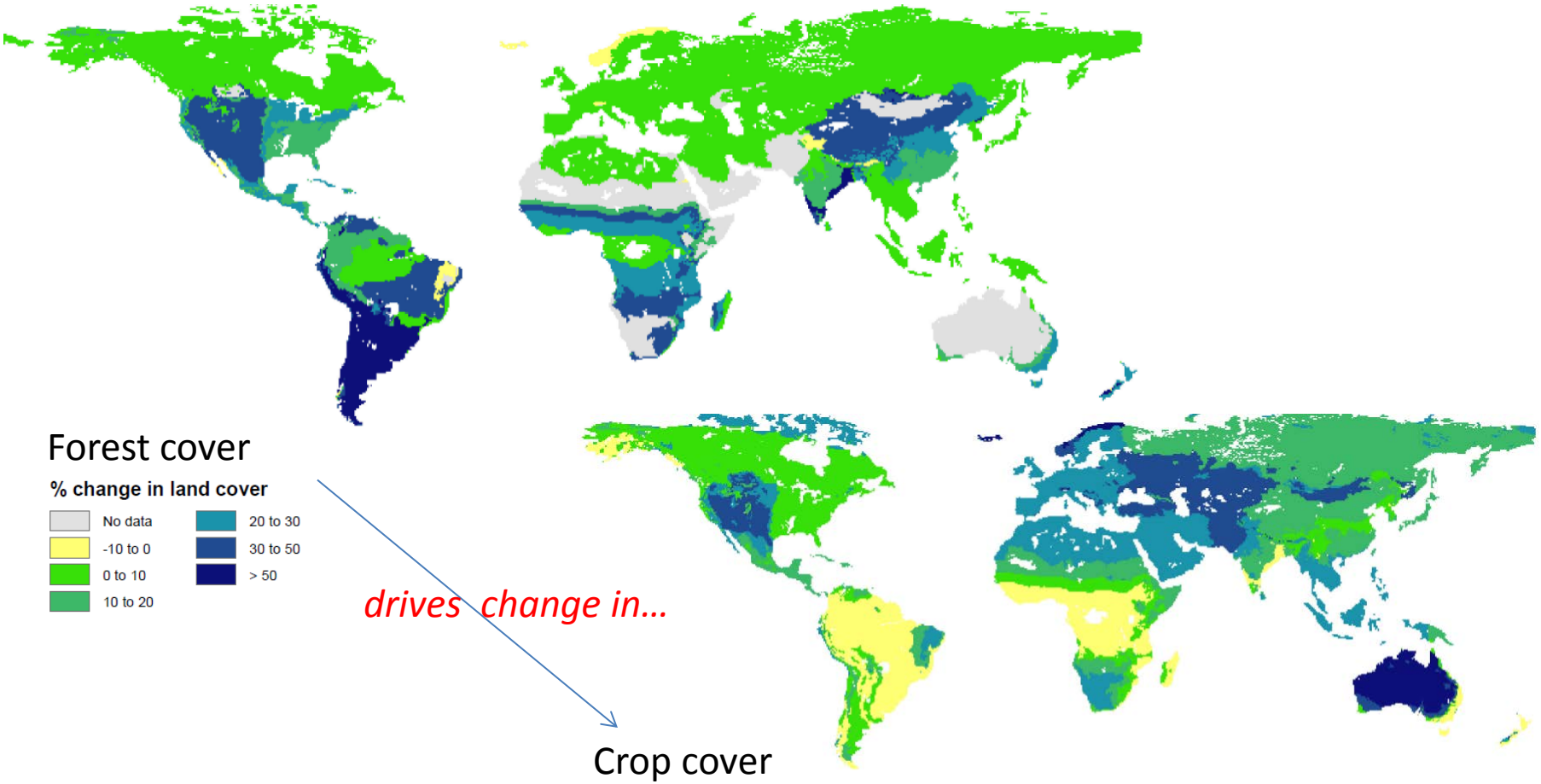
Abatement scenario B has a big impact on the pattern of *forest land* cover



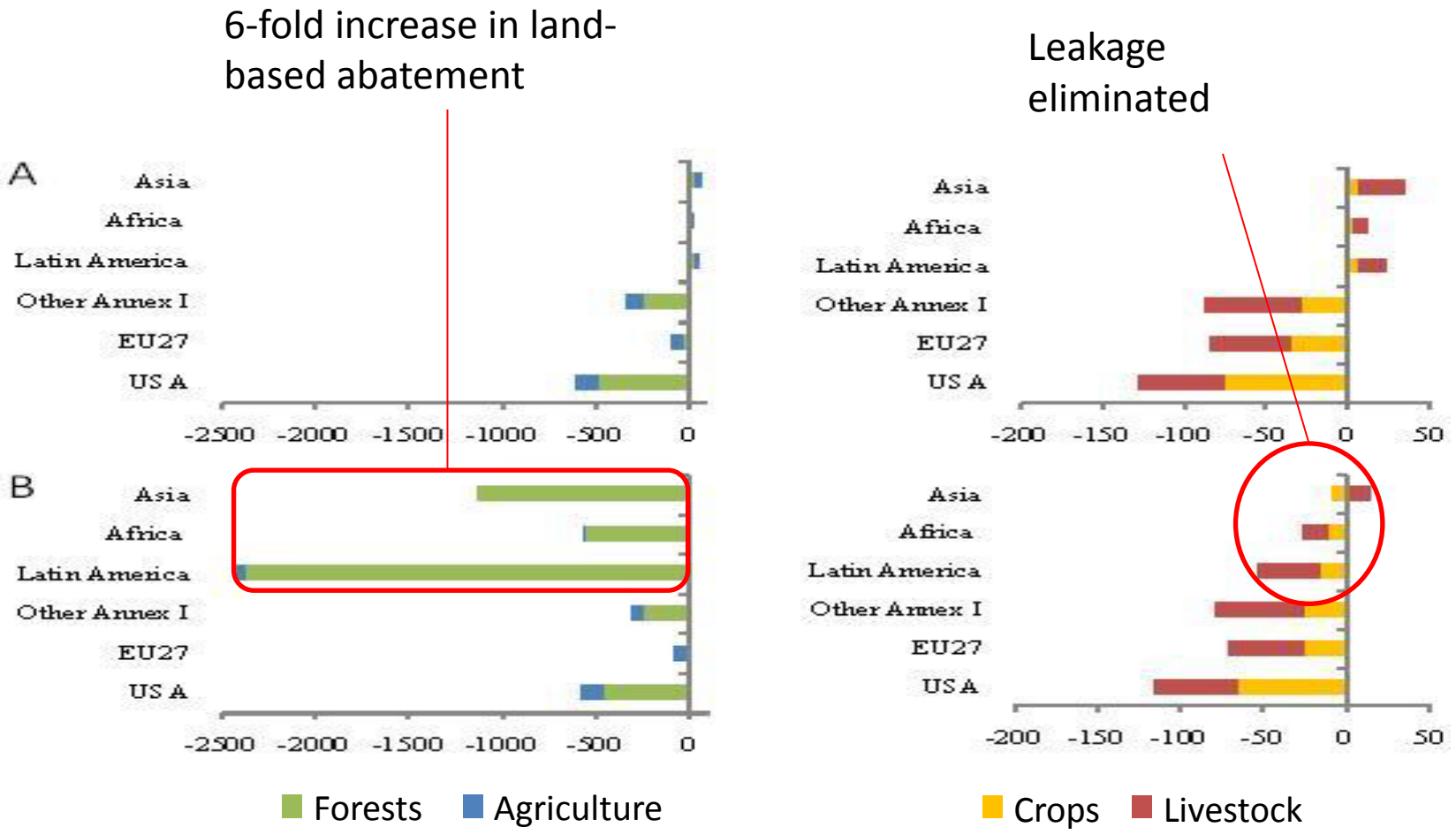
Forest cover expands in nearly all regions

Source: Golub et al., 2012

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



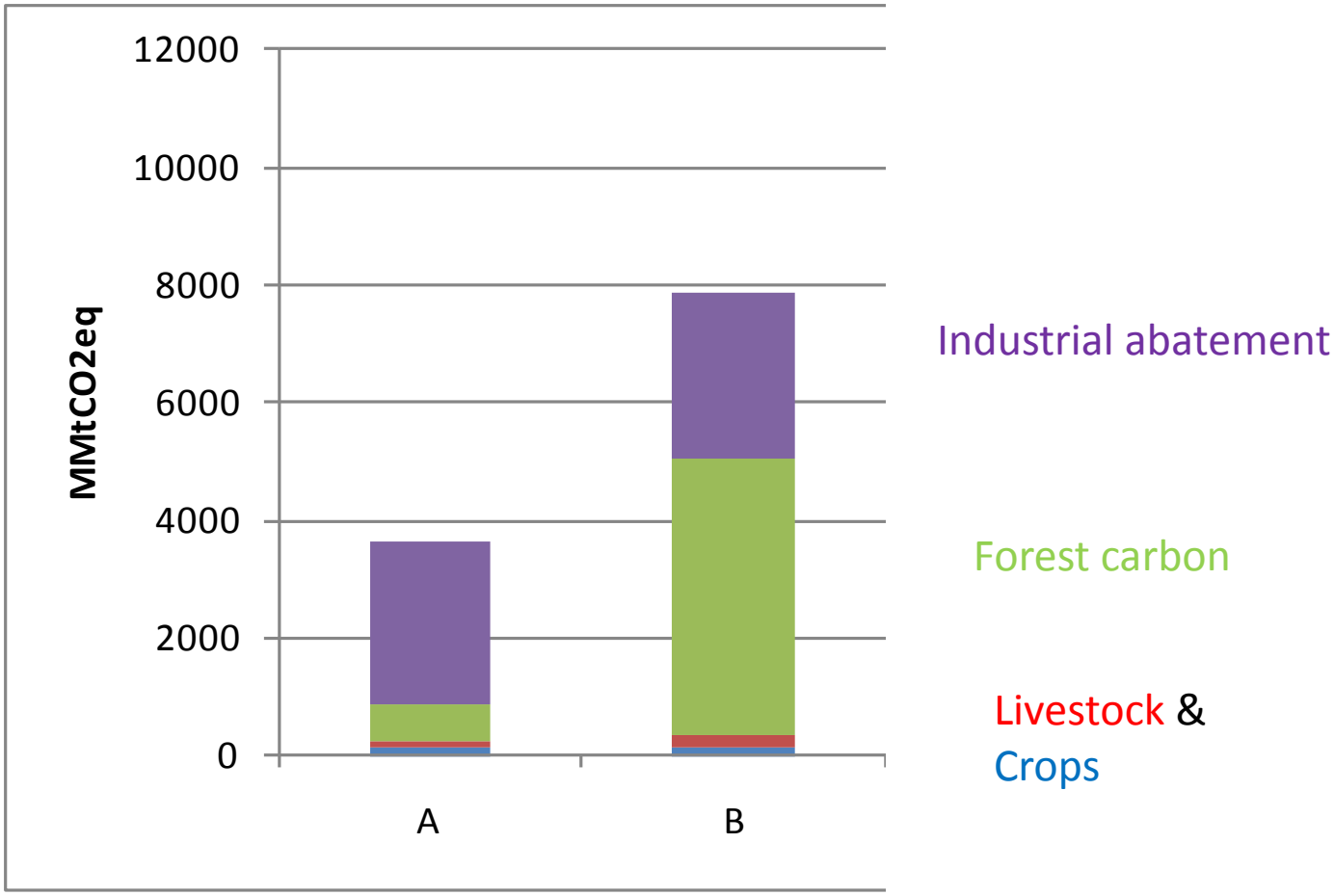
Source: Golub et al., 2012



Adding Forest Carbon Sequestration also curbs leakage

Source: Golub et al., 2012

Adding developing country forest carbon sequestration doubles global abatement

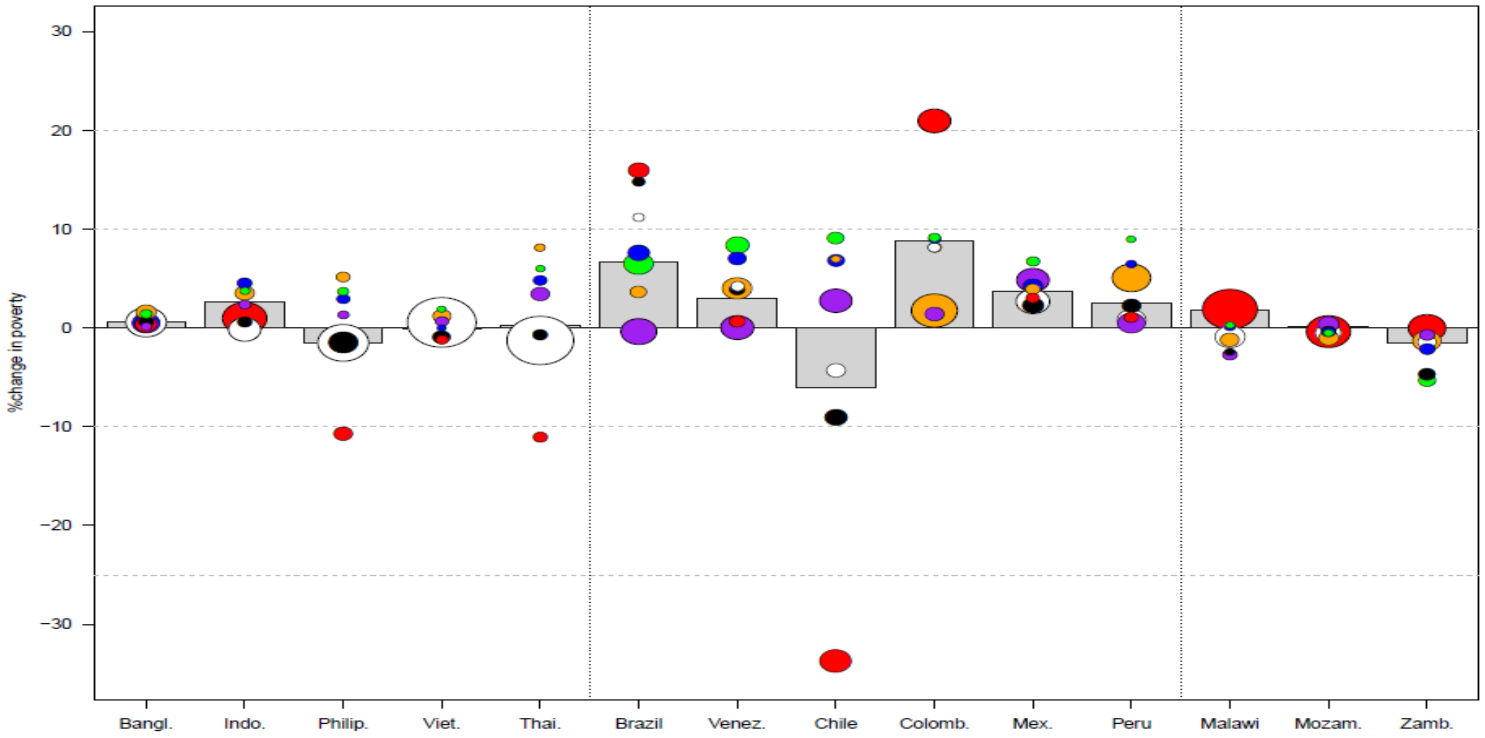


Source: Golub et al., 2012

In sum, there are good reasons to add forest tropical carbon forest sequestration to global policy mix

- Curbs agricultural leakage
- Boosts overall GHG emissions reduction and reduces cost of climate stabilization
- Income transfer to developing countries
- And its already happening!
- *What are the likely impacts on poverty?*
  - *Higher food prices hurt the poor*
  - *Income gains capitalized in land values*

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



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

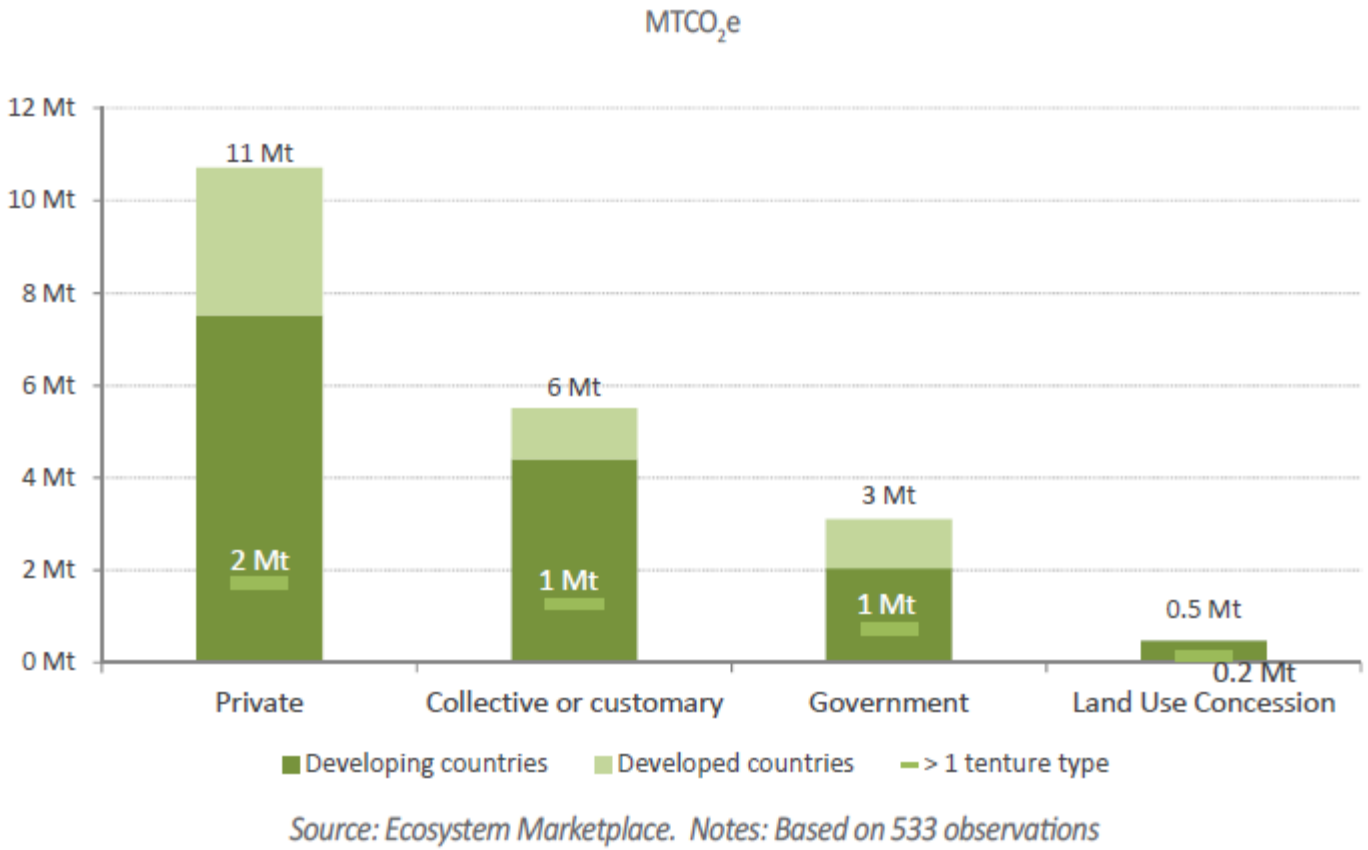
Source: Hussein et al., 2013

Summary:

- ***Poverty rises in 8 of 14 countries***
- Poverty results are driven by:
  - Higher food prices
  - Rise in returns to land
  - Decline in other factor returns
- Impacts depend heavily on land ownership

State of play with current carbon contracts (2011):
Majority of forest carbon offset volume flows to private land-owners:
Average carbon price for collective contracts is 50% higher

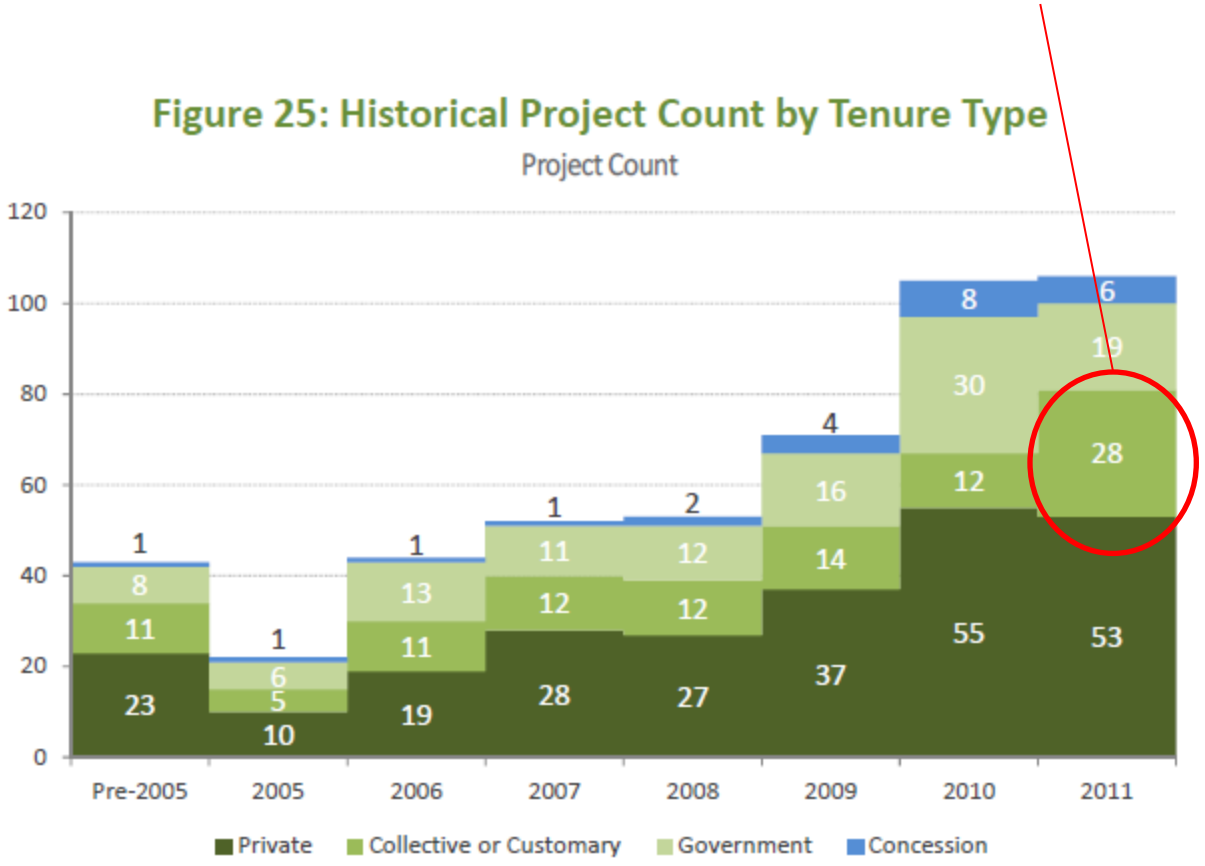
Figure 26: Transacted Volume by Tenure Type (Including >1 Tenure Type), and Location by Economic Designation



Source: Ecosystem Marketplace. Notes: Based on 533 observations

Source: Peters-Stanley et al., 2012

But the mix of contracts is evolving – recent growth in contracts with collective land-owners



Source: Ecosystem Marketplace. Note: Based on 150 responses.

Source: Peters-Stanley et al., 2012

Summary

- Climate policies can have large impacts on poverty
- Poverty impacts dominated by forest carbon sequestration incentives 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 carbon stocks, globally
  - Distribution of poor by AEZ
  - ***Spatial distribution of private and communal lands***
- ***GEOSHARE*** seeks to facilitate communication of data and analysis across local and global scales

GEOSHARE seeks to create interoperable global geospatial data bases for land, agriculture,environment and poverty

Global Land Use
Navin Ramankutty
McGill U.

Global Water Use in Agriculture
Stefan Siebert, U. Bonn

Global Climate
Noah Diffenbaugh
Stanford U.

GEOSHARE
Economic Analysis and 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
IFPRI

GEOSHARE Pilot Project Funded by DFID-DEFRA-USDA-CCAFS:

- **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

Global Land Use
Navin Ramankutty
McGill U.

Global Water Use in Agriculture
Stefan Siebert, U. Bonn

Global Climate
Noah Diffenbaugh
Stanford U.

GEOSHARE
Economic Analysis and 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

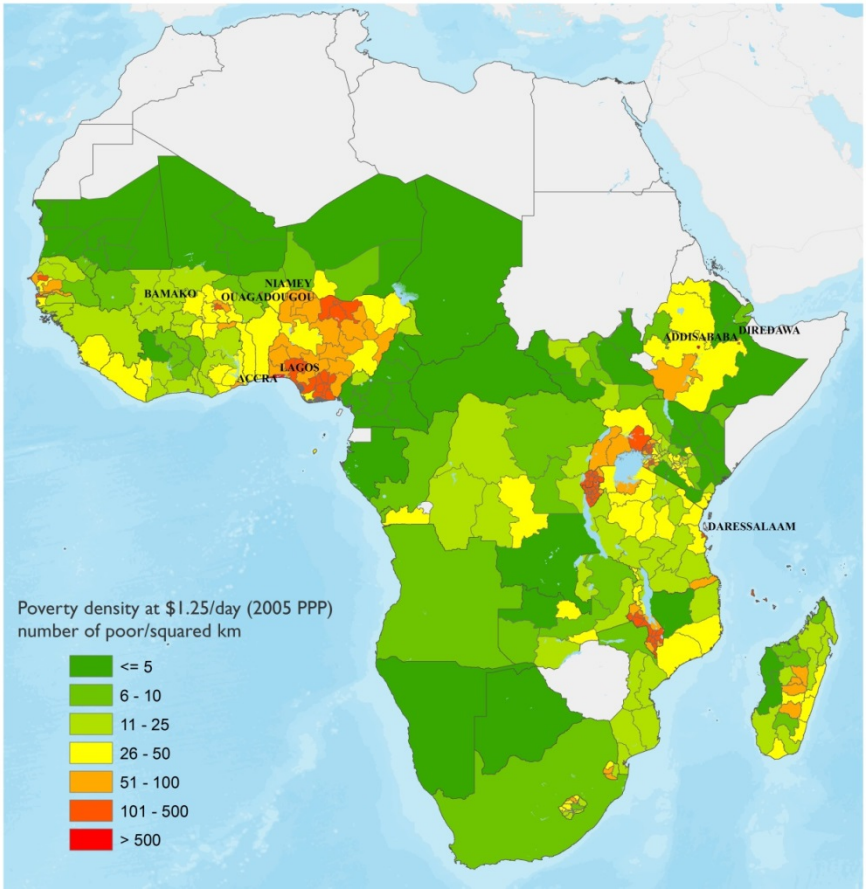
Agriculture, Environment, & Poverty in Africa
IFPRI

Land Tenure
Klaus Deininger, World Bank

Supplementary slides

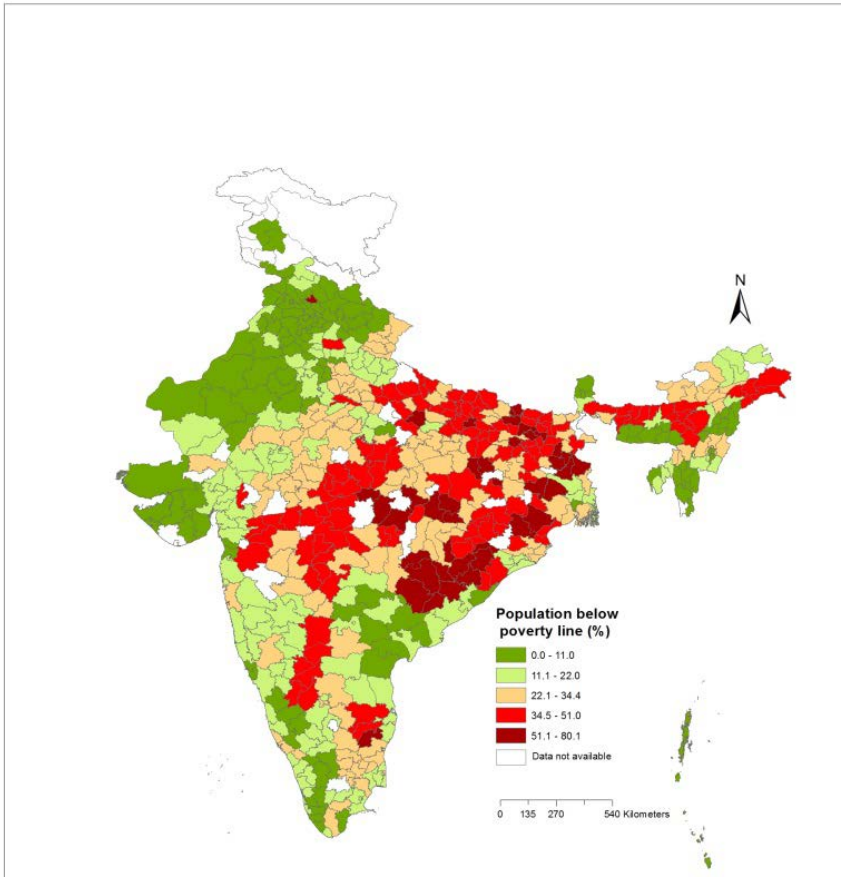
Need to understand the distribution of the poor across the landscape

Poverty density in Africa



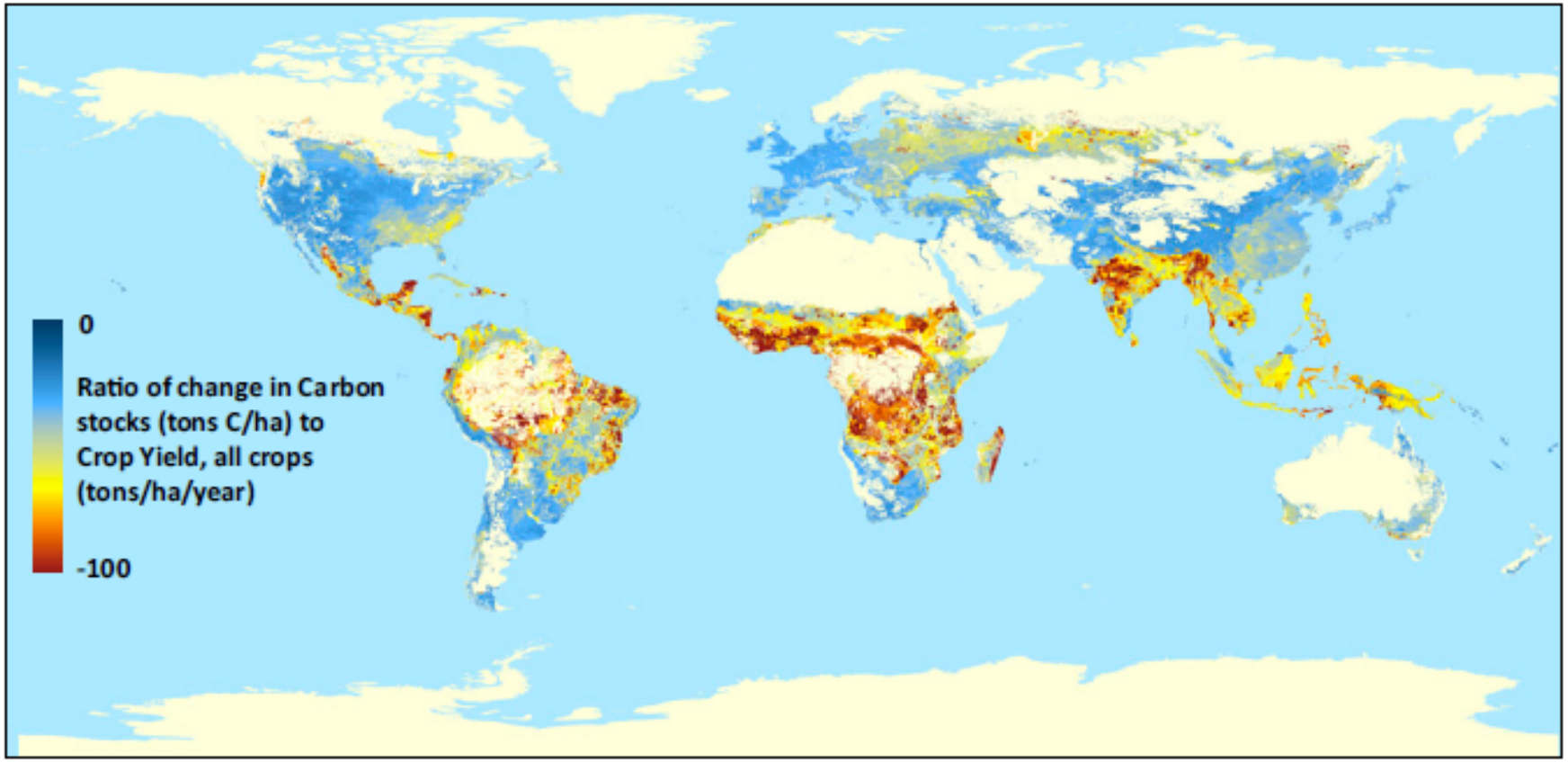
Source: Azzari et al., 2012

District level poverty in India



Source: Debroy and Bhandari, 2003

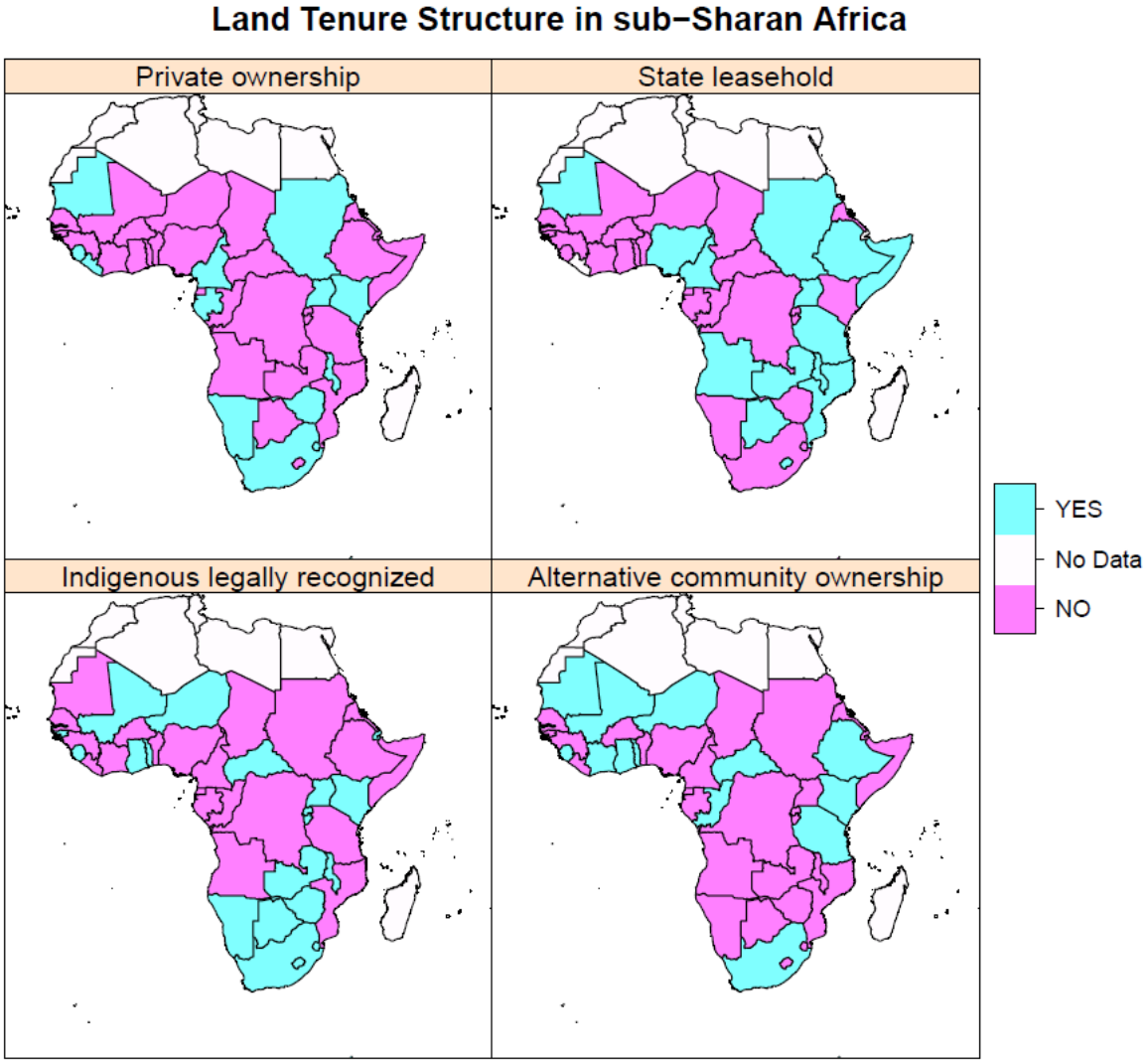
Need to understand the distribution of likely carbon sequestration



Change in carbon stock (tons C/ha) per unit of annual crop production flow (tons/ha/year)

Source: West et al., PNAS, 2010

Need to understand the geographic distribution of land tenure



Data Source: Bruce, 1998

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

References

Azzari, Carlos, Stanley Wood, Glenn Hyman, Elizabeth Barona, Melanie Bacou, and Zhe Guo. 2012. "Sub-national Poverty Map for Sub-Saharan Africa at 2005 International Poverty Lines (r12.12)." http://harvestchoice.org/.

Baumert, Kevin A., Timothy Herzog, and Jonathan Pershing. 2009. "Navigating the Numbers: Greenhouse Gas Data and International Climate Policy". Washington, DC, USA: World Resources Institute.

Bruce, John W. 1998. *Country Profiles of Land Tenure: Africa, 1996*. Research Report 130. Madison, WI: University of Wisconsin Land Tenure Center.

Debroy, B., and L. Bhandari. 2003. *District-level Deprivation in the New Millennium*. New Delhi: Konark.

Golub, A., T. Hertel, H. L Lee, S. Rose, and B. Sohngen. 2009. "The Opportunity Cost of Land Use and the Global Potential for Greenhouse Gas Mitigation in Agriculture and Forestry." *Resource and Energy Economics* 31 (4): 299–319.

Golub, Alla A., Benjamin B. Henderson, Thomas W. Hertel, Pierre J. Gerber, Steven K. Rose, and Brent Sohngen. 2012. "Global Climate Policy Impacts on Livestock, Land Use, Livelihoods, and Food Security." *Proceedings of the National Academy of Sciences* (September 27). doi:10.1073/pnas.1108772109. http://www.pnas.org/content/early/2012/09/26/1108772109.

Hertel, Thomas W, Roman Keeney, Maros Ivanic, and L. Alan Winters. 2009. "Why Isn't the Doha Development Agenda More Poverty Friendly?" *Review of Development Economics* 13 (4): 543–559. doi:10.1111/j.1467-9361.2008.00483.x.

Hertel, Thomas W., and Stephanie D. Rosch. 2010. "Climate Change, Agriculture, and Poverty." *Applied Economic Perspectives and Policy* 32 (3) (September 1): 355–385. doi:10.1093/aepp/ppq016.

Hussein, Zekarias, Thomas Hertel, and Alla Golub. 2013. "Poverty Impacts of Climate Mitigation Policy." *Under Review with Environmental Research Letters*.

Lee, Huey-Lin, Thomas W. Hertel, Brent Sohngen, and Navin Ramankutty. 2005. "Towards An Integrated Land Use Data Base for Assessing the Potential for Greenhouse Gas Mitigation". 25. GTAP Technical Paper. IN, USA: Center for Global Trade Analysis, Dept. of Agricultural Economics, Purdue University.

Peters-Stanley, Molly, Katherine Hamilton, and Daphne Yin. 2012. *Leveraging the Landscape: State of the Forest Carbon Markets 2012*. State of the Carbon Markets. Washington, D. C.: Ecosystem Marketplace.

Sohngen, Brent. 2010. "An Analysis of Forestry Carbon Sequestration as a Response to Climate Change". Copenhagen Consensus on Climate.

Verma, Monika, Thomas Warren Hertel, and Paul V. Preckel. 2011. "Predicting Within Country Household Food Expenditure Variation Using International Cross-section Estimates." *Economics Letters* 113 (3): 218–220.

West, Paul C., Holly K. Gibbs, Chad Monfreda, John Wagner, Carol C. Barford, Stephen R. Carpenter, and Jonathan A. Foley. 2010. "Trading Carbon for Food: Global Comparison of Carbon Stocks Vs. Crop Yields on Agricultural Land." *Proceedings of the National Academy of Sciences* 107 (46) (November 16): 19645–19648. doi:10.1073/pnas.1011078107.