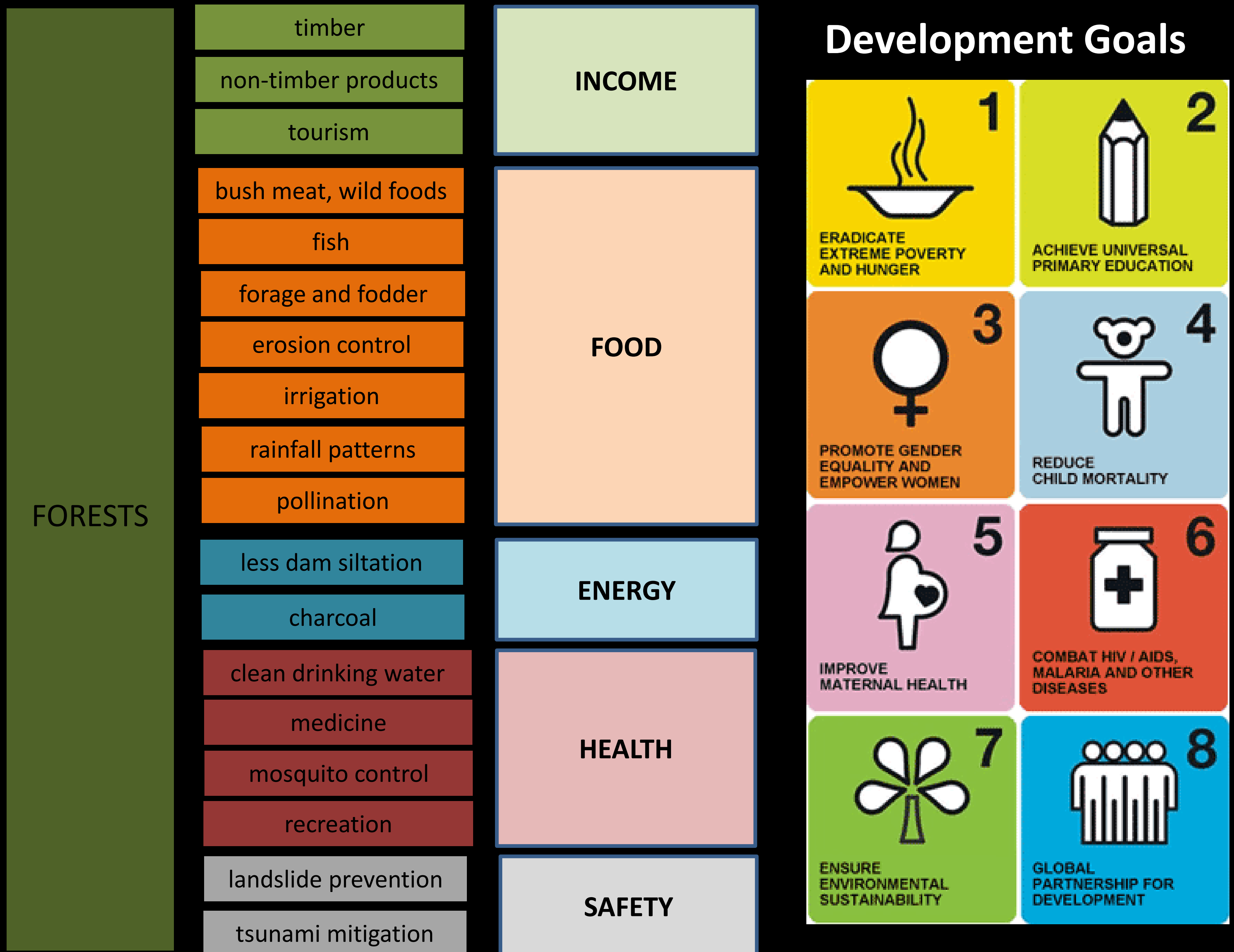
Key policy issues and challenges for forests

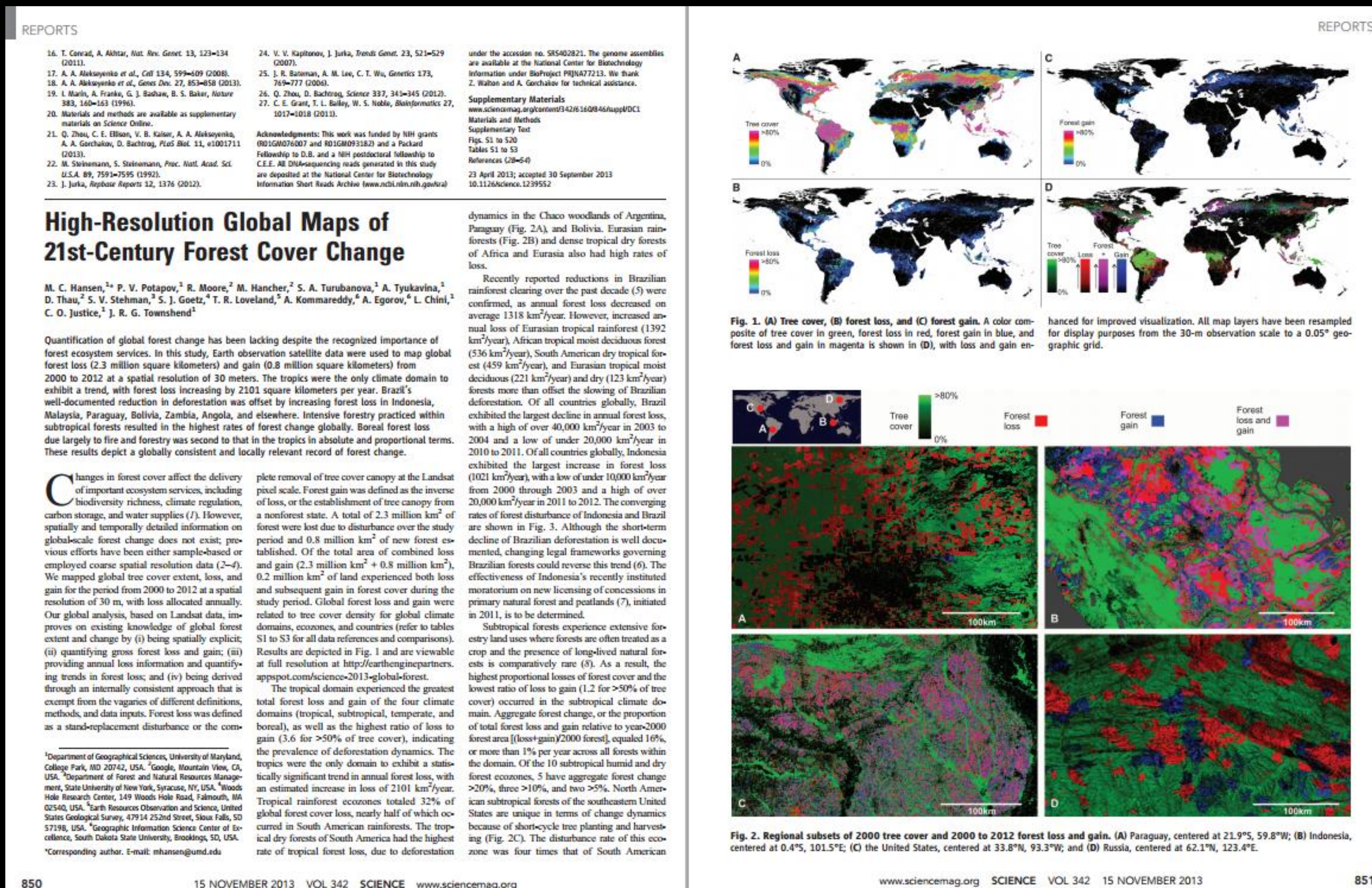
Presentation to WAVES
Global Workshop on Forest Accounting
May 11, 2014


FORESTS
timber
non-timber products
tourism
bush meat, wild foods
fish
forage and fodder
erosion control
irrigation
rainfall patterns
pollination
less dam siltation
charcoal
clean drinking water
medicine
mosquito control
recreation
landslide prevention
tsunami mitigation
INCOME
FOOD
ENERGY
HEALTH
SAFETY
Development Goals
1
ERADICATE EXTREME POVERTY AND HUNGER
2
ACHIEVE UNIVERSAL PRIMARY EDUCATION
3
PROMOTE GENDER EQUALITY AND EMPOWER WOMEN
4
REDUCE CHILD MORTALITY
5
IMPROVE MATERNAL HEALTH
6
COMBAT HIV / AIDS, MALARIA AND OTHER DISEASES
7
ENSURE ENVIRONMENTAL SUSTAINABILITY
8
GLOBAL PARTNERSHIP FOR DEVELOPMENT

What’s happening to the world’s forests, and what are the implications?

First, the good news:

Information on forests has never been better….



16. T. Conrad, A. Akhtar, *Nat. Rev. Genet.* 13, 123–134 (2011).
17. A. A. Alekseyenko *et al.*, *Cell* 134, 599–609 (2008).
18. A. A. Alekseyenko *et al.*, *Genes Dev.* 27, 853–858 (2013).
19. I. Marín, A. Franke, G. J. Bashaw, B. S. Baker, *Nature* 383, 160–163 (1996).
20. Materials and methods are available as supplementary materials on *Science* Online.
21. Q. Zhou, C. E. Ellison, V. B. Kaiser, A. A. Alekseyenko, A. A. Gorchakov, D. Bachtrog, *PLoS Biol.* 11, e1001711 (2013).
22. M. Steinemann, S. Steinemann, *Proc. Natl. Acad. Sci. U.S.A.* 89, 7591–7595 (1992).
23. J. Jurka, *Repbase Reports* 12, 1376 (2012).
24. V. V. Kapitonov, J. Jurka, *Trends Genet.* 23, 521–529 (2007).
25. J. R. Bateman, A. M. Lee, C. T. Wu, *Genetics* 173, 769–777 (2006).
26. Q. Zhou, D. Bachtrog, *Science* 337, 341–345 (2012).
27. C. E. Grant, T. L. Bailey, W. S. Noble, *Bioinformatics* 27, 1017–1018 (2011).

Acknowledgments: This work was funded by NIH grants (R01GM076007 and R01GM093182) and a Packard Fellowship to D.B. and a NIH postdoctoral fellowship to C.E.E. All DNA-sequencing reads generated in this study are deposited at the National Center for Biotechnology Information Short Reads Archive (www.ncbi.nlm.nih.gov/sra) under the accession no. SRS402821. The genome assemblies are available at the National Center for Biotechnology Information under BioProject PRJNA77213. We thank Z. Walton and A. Gorchakov for technical assistance.

Supplementary Materials
www.sciencemag.org/content/342/6160/846/suppl/DC1
Materials and Methods
Supplementary Text
Figs. S1 to S20
Tables S1 to S3
References (28–64)

23 April 2013; accepted 30 September 2013
10.1126/science.1239552

High-Resolution Global Maps of 21st-Century Forest Cover Change

M. C. Hansen,[1*] P. V. Potapov,[1] R. Moore,[2] M. Hancher,[2] S. A. Turubanova,[1] A. Tyukavina,[1] D. Thau,[2] S. V. Stehman,[3] S. J. Goetz,[4] T. R. Loveland,[5] A. Kommareddy,[6] A. Egorov,[6] L. Chini,[1] C. O. Justice,[1] J. R. G. Townshend[1]

Quantification of global forest change has been lacking despite the recognized importance of forest ecosystem services. In this study, Earth observation satellite data were used to map global forest loss (2.3 million square kilometers) and gain (0.8 million square kilometers) from 2000 to 2012 at a spatial resolution of 30 meters. The tropics were the only climate domain to exhibit a trend, with forest loss increasing by 2101 square kilometers per year. Brazil's well-documented reduction in deforestation was offset by increasing forest loss in Indonesia, Malaysia, Paraguay, Bolivia, Zambia, Angola, and elsewhere. Intensive forestry practiced within subtropical forests resulted in the highest rates of forest change globally. Boreal forest loss due largely to fire and forestry was second to that in the tropics in absolute and proportional terms. These results depict a globally consistent and locally relevant record of forest change.

Changes in forest cover affect the delivery of important ecosystem services, including biodiversity richness, climate regulation, carbon storage, and water supplies (*1*). However, spatially and temporally detailed information on global-scale forest change does not exist; previous efforts have been either sample-based or employed coarse spatial resolution data (*2*–*4*). We mapped global tree cover extent, loss, and gain for the period from 2000 to 2012 at a spatial resolution of 30 m, with loss allocated annually. Our global analysis, based on Landsat data, improves on existing knowledge of global forest extent and change by (i) being spatially explicit; (ii) quantifying gross forest loss and gain; (iii) providing annual loss information and quantifying trends in forest loss; and (iv) being derived through an internally consistent approach that is exempt from the vagaries of different definitions, methods, and data inputs. Forest loss was defined as a stand-replacement disturbance or the complete removal of tree cover canopy at the Landsat pixel scale. Forest gain was defined as the inverse of loss, or the establishment of tree canopy from a nonforest state. A total of 2.3 million km^2 of forest were lost due to disturbance over the study period and 0.8 million km^2 of new forest established. Of the total area of combined loss and gain (2.3 million km^2 + 0.8 million km^2), 0.2 million km^2 of land experienced both loss and subsequent gain in forest cover during the study period. Global forest loss and gain were related to tree cover density for global climate domains, ecozones, and countries (refer to tables S1 to S3 for all data references and comparisons). Results are depicted in Fig. 1 and are viewable at full resolution at http://earthenginepartners.appspot.com/science-2013-global-forest.

The tropical domain experienced the greatest total forest loss and gain of the four climate domains (tropical, subtropical, temperate, and boreal), as well as the highest ratio of loss to gain (3.6 for >50% of tree cover), indicating the prevalence of deforestation dynamics. The tropics were the only domain to exhibit a statistically significant trend in annual forest loss, with an estimated increase in loss of 2101 km^2/year. Tropical rainforest ecozones totaled 32% of global forest cover loss, nearly half of which occurred in South American rainforests. The tropical dry forests of South America had the highest rate of tropical forest loss, due to deforestation dynamics in the Chaco woodlands of Argentina, Paraguay (Fig. 2A), and Bolivia. Eurasian rainforests (Fig. 2B) and dense tropical dry forests of Africa and Eurasia also had high rates of loss.

Recently reported reductions in Brazilian rainforest clearing over the past decade (*5*) were confirmed, as annual forest loss decreased on average 1318 km^2/year. However, increased annual loss of Eurasian tropical rainforest (1392 km^2/year), African tropical moist deciduous forest (536 km^2/year), South American dry tropical forest (459 km^2/year), and Eurasian tropical moist deciduous (221 km^2/year) and dry (123 km^2/year) forests more than offset the slowing of Brazilian deforestation. Of all countries globally, Brazil exhibited the largest decline in annual forest loss, with a high of over 40,000 km^2/year in 2003 to 2004 and a low of under 20,000 km^2/year in 2010 to 2011. Of all countries globally, Indonesia exhibited the largest increase in forest loss (1021 km^2/year), with a low of under 10,000 km^2/year from 2000 through 2003 and a high of over 20,000 km^2/year in 2011 to 2012. The converging rates of forest disturbance of Indonesia and Brazil are shown in Fig. 3. Although the short-term decline of Brazilian deforestation is well documented, changing legal frameworks governing Brazilian forests could reverse this trend (*6*). The effectiveness of Indonesia's recently instituted moratorium on new licensing of concessions in primary natural forest and peatlands (*7*), initiated in 2011, is to be determined.

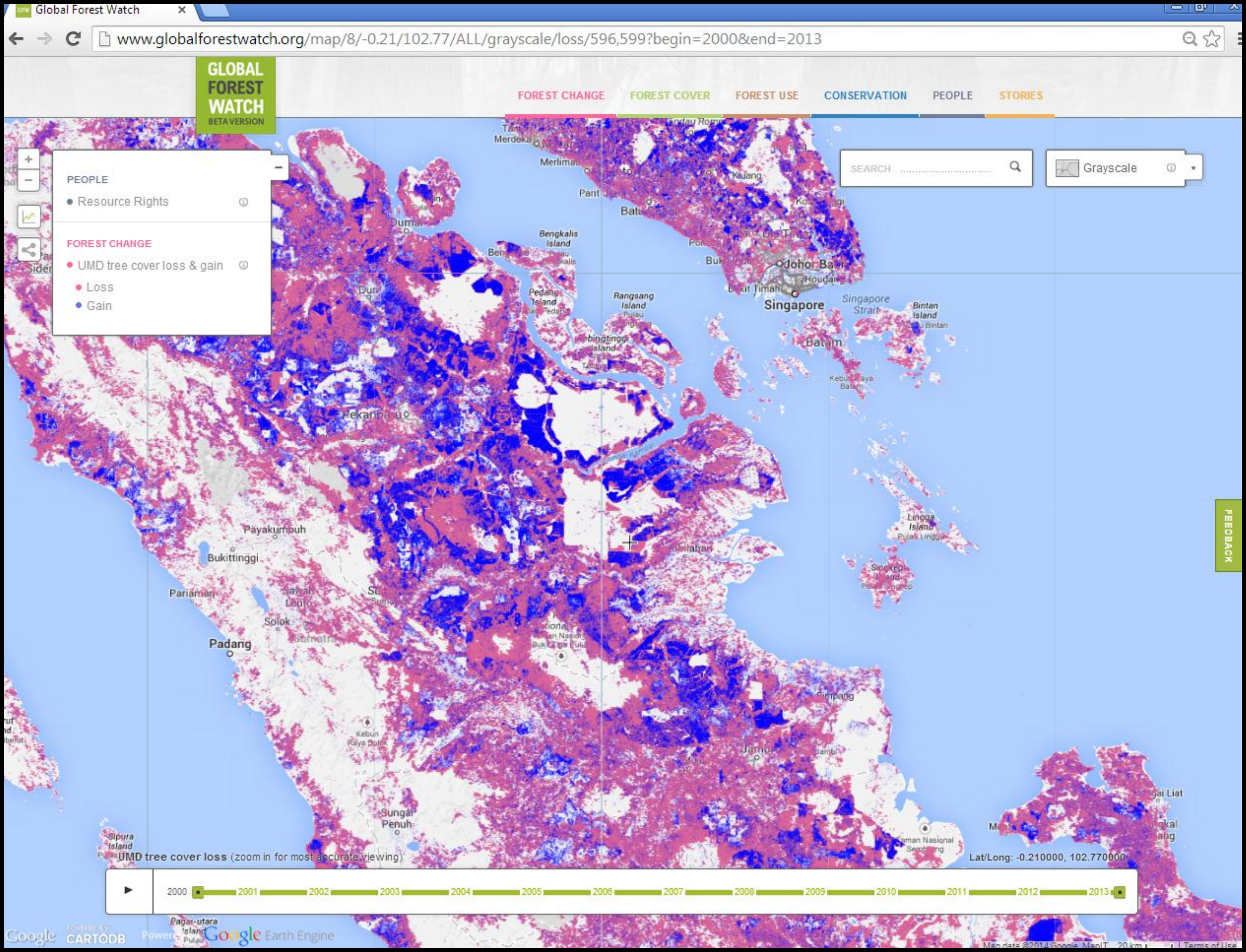
Subtropical forests experience extensive forestry land uses where forests are often treated as a crop and the presence of long-lived natural forests is comparatively rare (*8*). As a result, the highest proportional losses of forest cover and the lowest ratio of loss to gain (1.2 for >50% of tree cover) occurred in the subtropical climate domain. Aggregate forest change, or the proportion of total forest loss and gain relative to year-2000 forest area [(loss+gain)/2000 forest], equaled 16%, or more than 1% per year across all forests within the domain. Of the 10 subtropical humid and dry forest ecozones, 5 have aggregate forest change >20%, three >10%, and two >5%. North American subtropical forests of the southeastern United States are unique in terms of change dynamics because of short-cycle tree planting and harvesting (Fig. 2C). The disturbance rate of this ecozone was four times that of South American

[1]Department of Geographical Sciences, University of Maryland, College Park, MD 20742, USA. [2]Google, Mountain View, CA, USA. [3]Department of Forest and Natural Resources Management, State University of New York, Syracuse, NY, USA. [4]Woods Hole Research Center, 149 Woods Hole Road, Falmouth, MA 02540, USA. [5]Earth Resources Observation and Science, United States Geological Survey, 47914 252nd Street, Sioux Falls, SD 57198, USA. [6]Geographic Information Science Center of Excellence, South Dakota State University, Brookings, SD, USA.
*Corresponding author. E-mail: mhansen@umd.edu

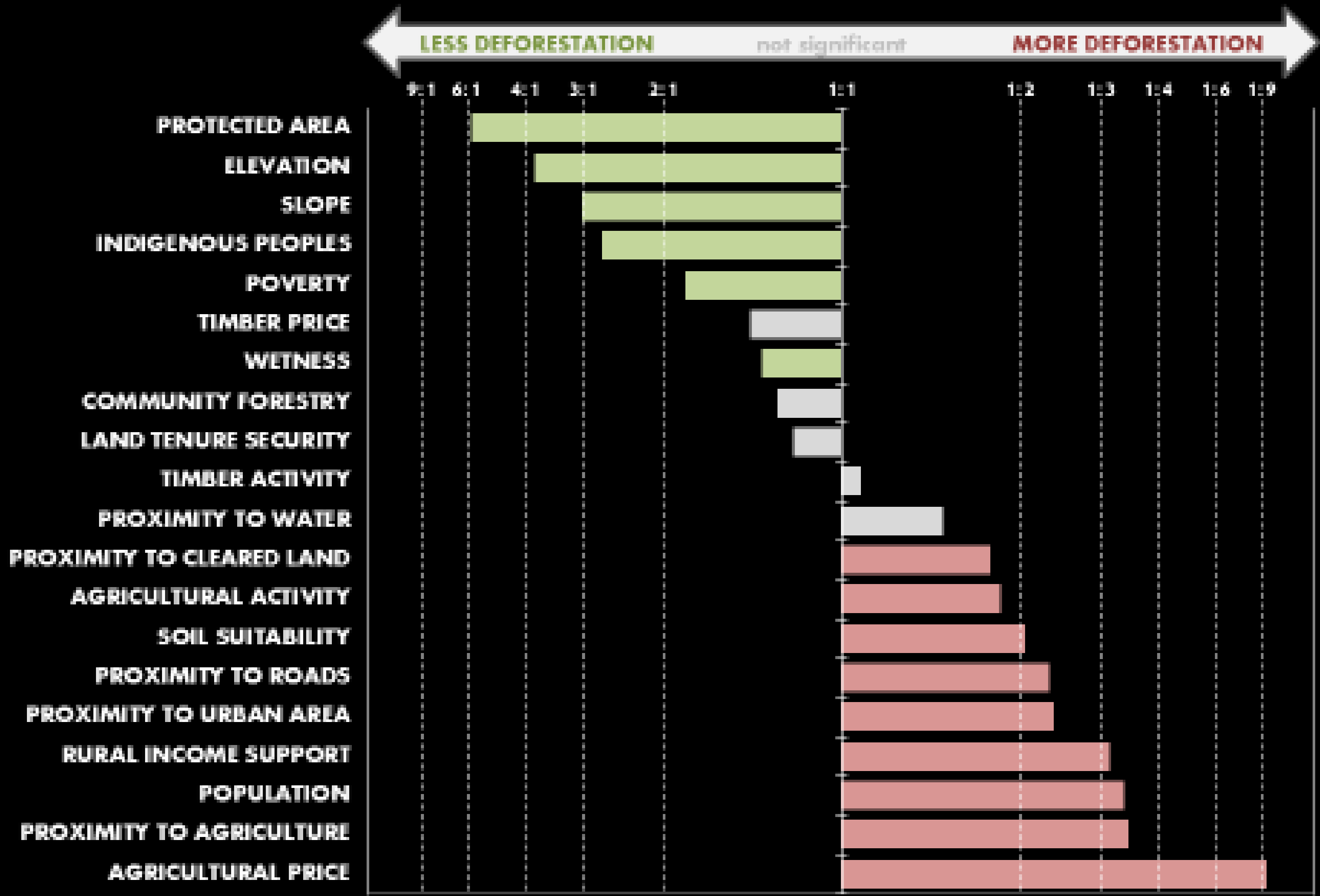
Fig. 1. (A) Tree cover, (B) forest loss, and (C) forest gain. A color composite of tree cover in green, forest loss in red, forest gain in blue, and forest loss and gain in magenta is shown in **(D)**, with loss and gain enhanced for improved visualization. All map layers have been resampled for display purposes from the 30-m observation scale to a 0.05° geographic grid.

Fig. 2. Regional subsets of 2000 tree cover and 2000 to 2012 forest loss and gain. (A) Paraguay, centered at 21.9°S, 59.8°W; **(B)** Indonesia, centered at 0.4°S, 101.5°E; **(C)** the United States, centered at 33.8°N, 93.3°W; and **(D)** Russia, centered at 62.1°N, 123.4°E.

...or more accessible

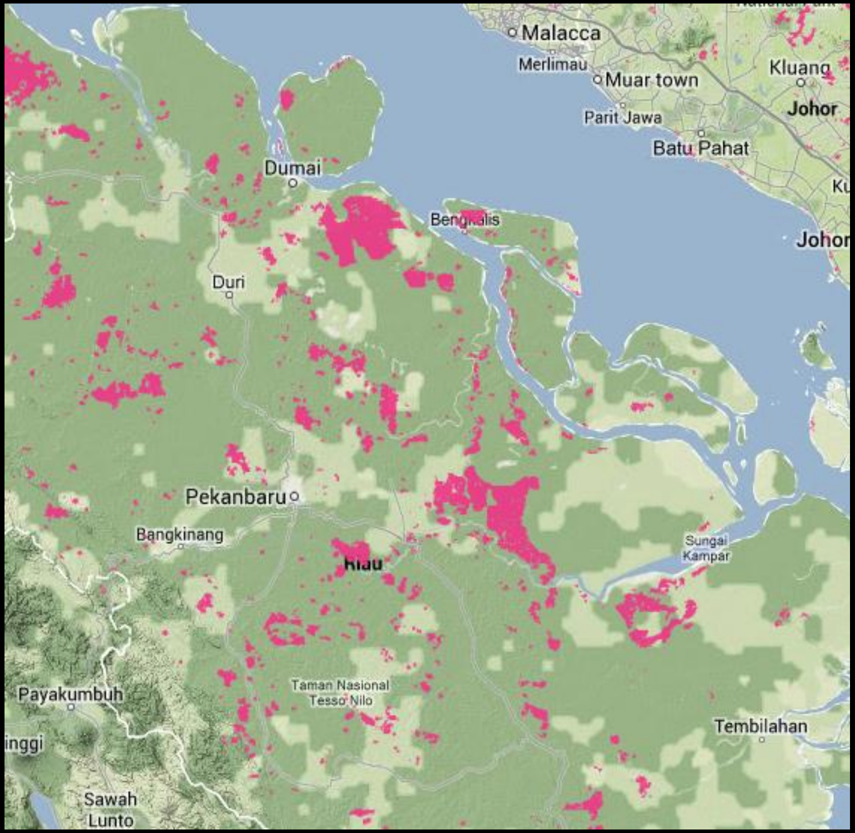


We know what drives deforestation…



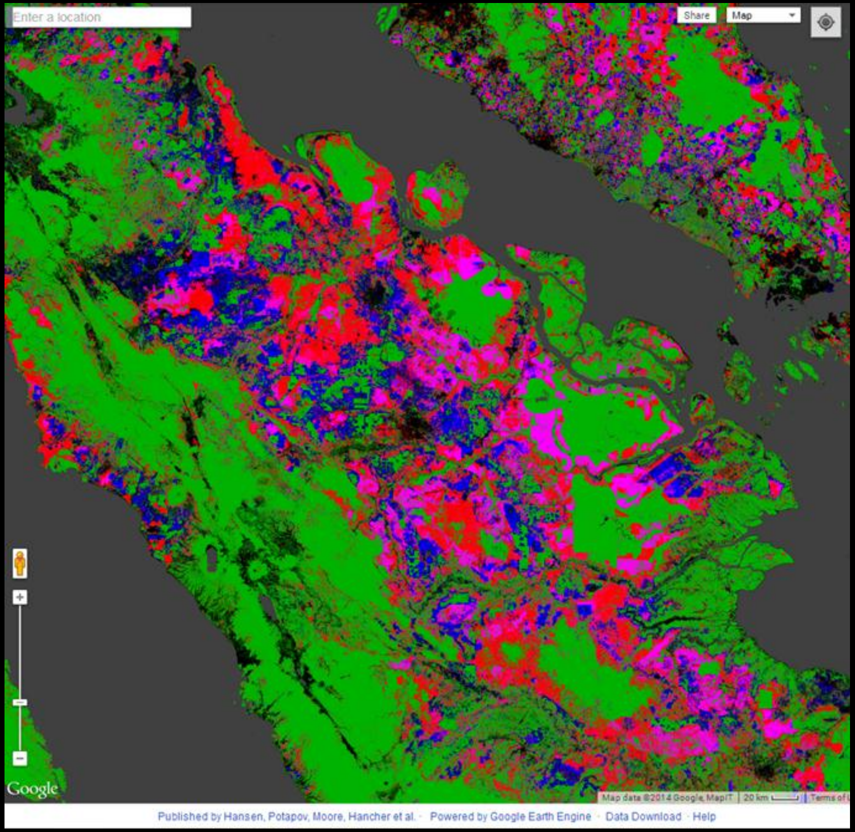
Ratio of regression coefficients showing significant negative association with deforestation to regression coefficients showing significant positive association with deforestation, based on [illegible] regression coefficients in 117 spatially explicit econometric studies.
Source: Ferretti-Gallon and Busch, CGD Working Paper #361 (2014)

…and can track and respond to change



High temporal resolution

for near real-time monitoring and response

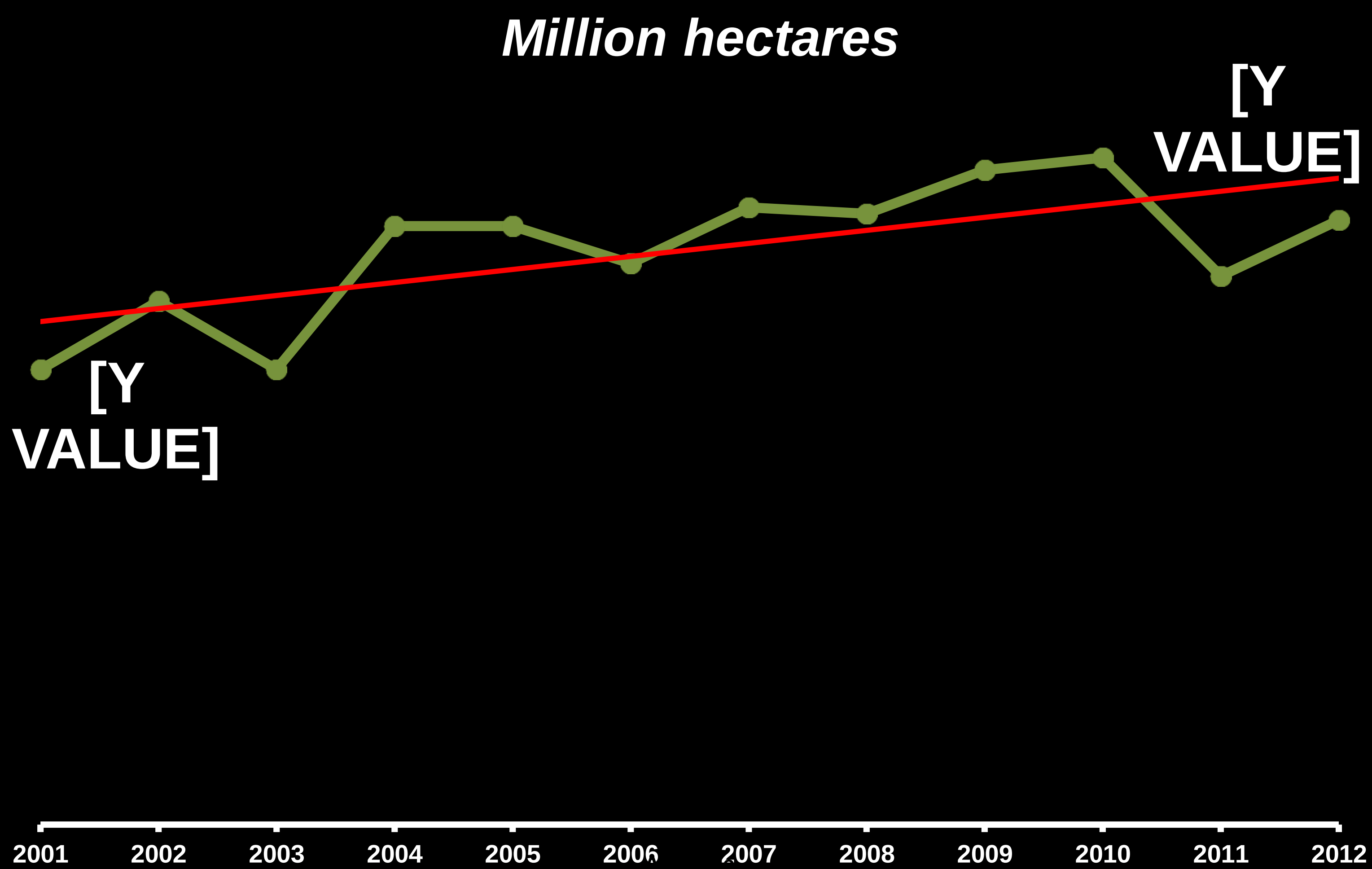


High spatial resolution

for accurate measurement of annual deforestation

Now, the bad news:

Tropical deforestation has been *increasing*



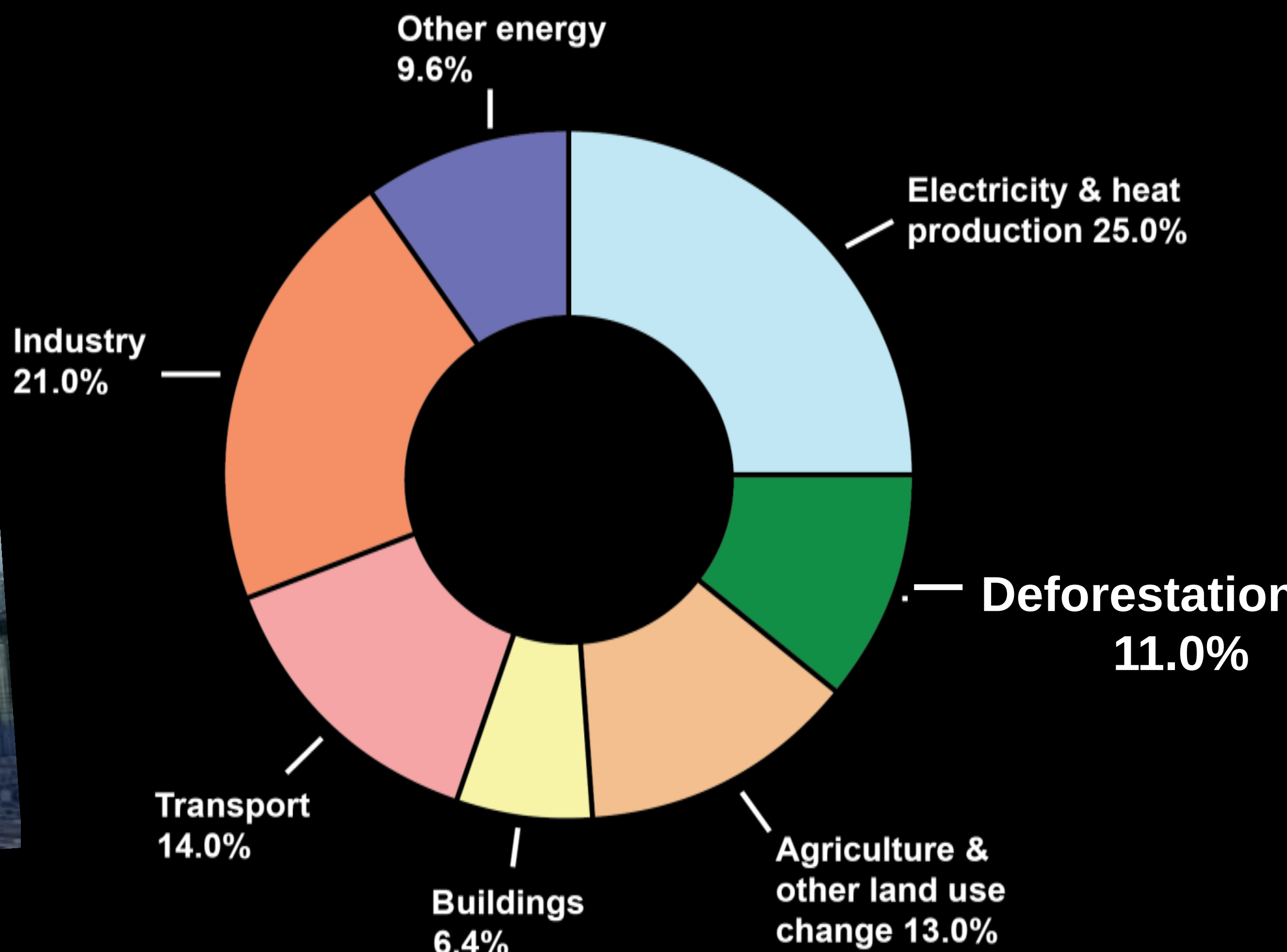
Source: Hansen *et al.,* 2013

Forest Loss in Riau, Indonesia, 2000-2012. Source: Hansen, Potapov, Moore, Hancher, et al. (Science, 2013). Powered by Google Earth Engine




Implications of deforestation for biodiversity

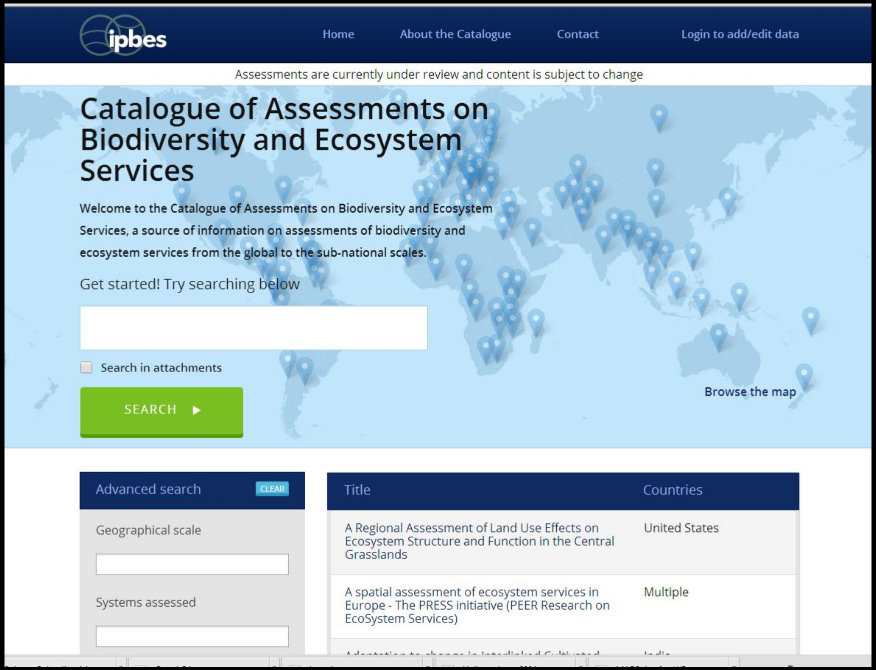
Implications of deforestation for climate change



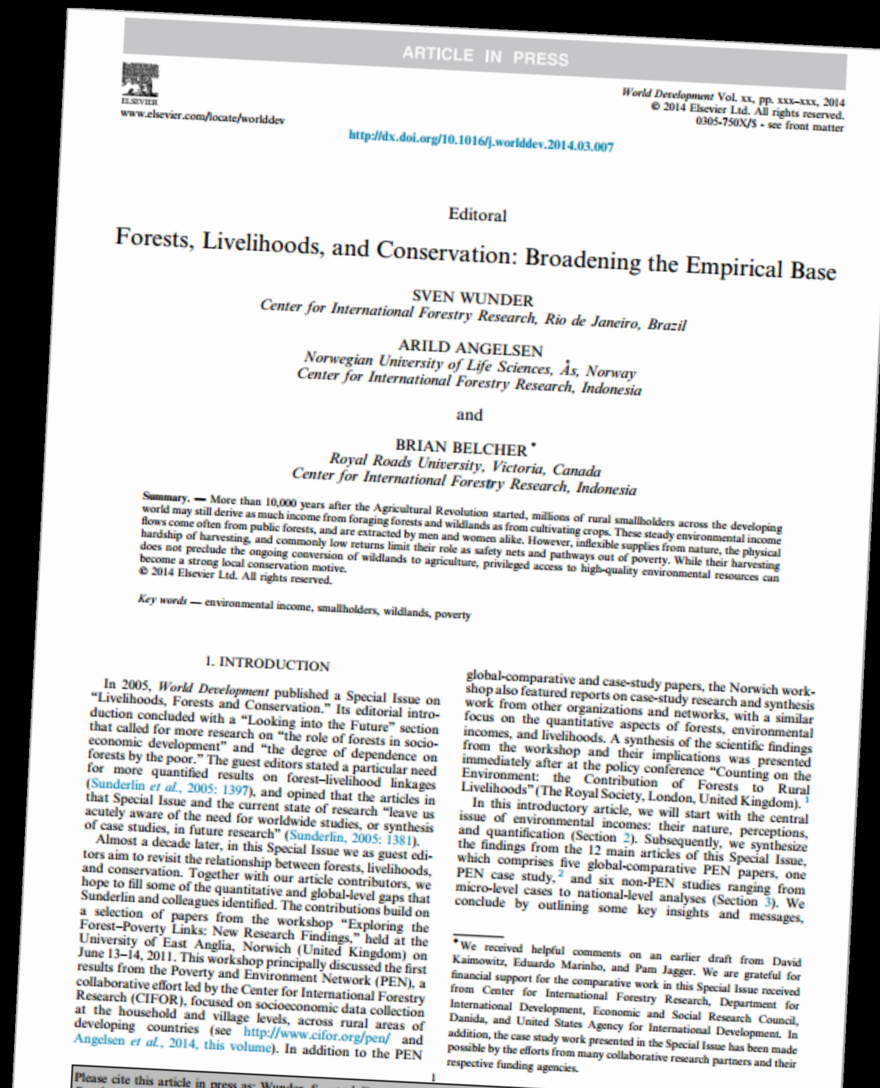
Data Source: IPCC, AR5 WGIII Report , 2014

Implications of deforestation for ecosystem services

ipbes
Science and Policy
for People and Nature



Implications of deforestation for livelihoods and national economies



ARTICLE IN PRESS

www.elsevier.com/locate/worlddev

World Development Vol. xx, pp. xxx–xxx, 2014

0305-750X/$ - see front matter

http://dx.doi.org/10.1016/j.worlddev.2014.03.007

Editoral

Forests, Livelihoods, and Conservation: Broadening the Empirical Base

SVEN WUNDER
Center for International Forestry Research, Rio de Janeiro, Brazil

ARILD ANGELSEN
Norwegian University of Life Sciences, Ås, Norway
Center for International Forestry Research, Indonesia

and

BRIAN BELCHER *
Royal Roads University, Victoria, Canada
Center for International Forestry Research, Indonesia

Summary. — 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. These steady environmental income flows come often from public forests, and are extracted by men and women alike. However, inflexible supplies from nature, the physical hardship of harvesting, and commonly low returns limit their role as safety nets and pathways out of poverty. While their harvesting does not preclude the ongoing conversion of wildlands to agriculture, privileged access to high-quality environmental resources can become a strong local conservation motive.

Key words — environmental income, smallholders, wildlands, poverty

1. INTRODUCTION

In 2005, *World Development* published a Special Issue on "Livelihoods, Forests and Conservation." Its editorial introduction concluded with a "Looking into the Future" section that called for more research on "the role of forests in socio-economic development" and "the degree of dependence on forests by the poor." The guest editors stated a particular need for more quantified results on forest–livelihood linkages (Sunderlin *et al.*, 2005: 1397), and opined that the articles in that Special Issue and the current state of research "leave us acutely aware of the need for worldwide studies, or synthesis of case studies, in future research" (Sunderlin, 2005: 1381).

Almost a decade later, in this Special Issue we as guest editors aim to revisit the relationship between forests, livelihoods, and conservation. Together with our article contributors, we hope to fill some of the quantitative and global-level gaps that Sunderlin and colleagues identified. The contributions build on a selection of papers from the workshop "Exploring the Forest–Poverty Links: New Research Findings," held at the University of East Anglia, Norwich (United Kingdom) on June 13–14, 2011. This workshop principally discussed the first results from the Poverty and Environment Network (PEN), a collaborative effort led by the Center for International Forestry Research (CIFOR), focused on socioeconomic data collection at the household and village levels, across rural areas of developing countries (see http://www.cifor.org/pen/ and Angelsen *et al.*, 2014, this volume). In addition to the PEN global-comparative and case-study papers, the Norwich workshop also featured reports on case-study research and synthesis work from other organizations and networks, with a similar focus on the quantitative aspects of forests, environmental incomes, and livelihoods. A synthesis of the scientific findings from the workshop and their implications was presented immediately after at the policy conference "Counting on the Environment: the Contribution of Forests to Rural Livelihoods" (The Royal Society, London, United Kingdom).[1]

In this introductory article, we will start with the central issue of environmental incomes: their nature, perceptions, and quantification (Section 2). Subsequently, we synthesize the findings from the 12 main articles of this Special Issue, which comprises five global-comparative PEN papers, one PEN case study,[2] and six non-PEN studies ranging from micro-level cases to national-level analyses (Section 3). We conclude by outlining some key insights and messages,

* We received helpful comments on an earlier draft from David Kaimowitz, Eduardo Marinho, and Pam Jagger. We are grateful for financial support for the comparative work in this Special Issue received from Center for International Forestry Research, Department for International Development, Economic and Social Research Council, Danida, and United States Agency for International Development. In addition, the case study work presented in the Special Issue has been made possible by the efforts from many collaborative research partners and their respective funding agencies.

Please cite this article in press as: Wunder, S. ...

What’s the national forest agenda?

Value current forest livelihoods

21%

Source: Wunder et al, World Development Report (2014)

Enhance revenues from forests managed as forests

REDD+

Value forests for food security

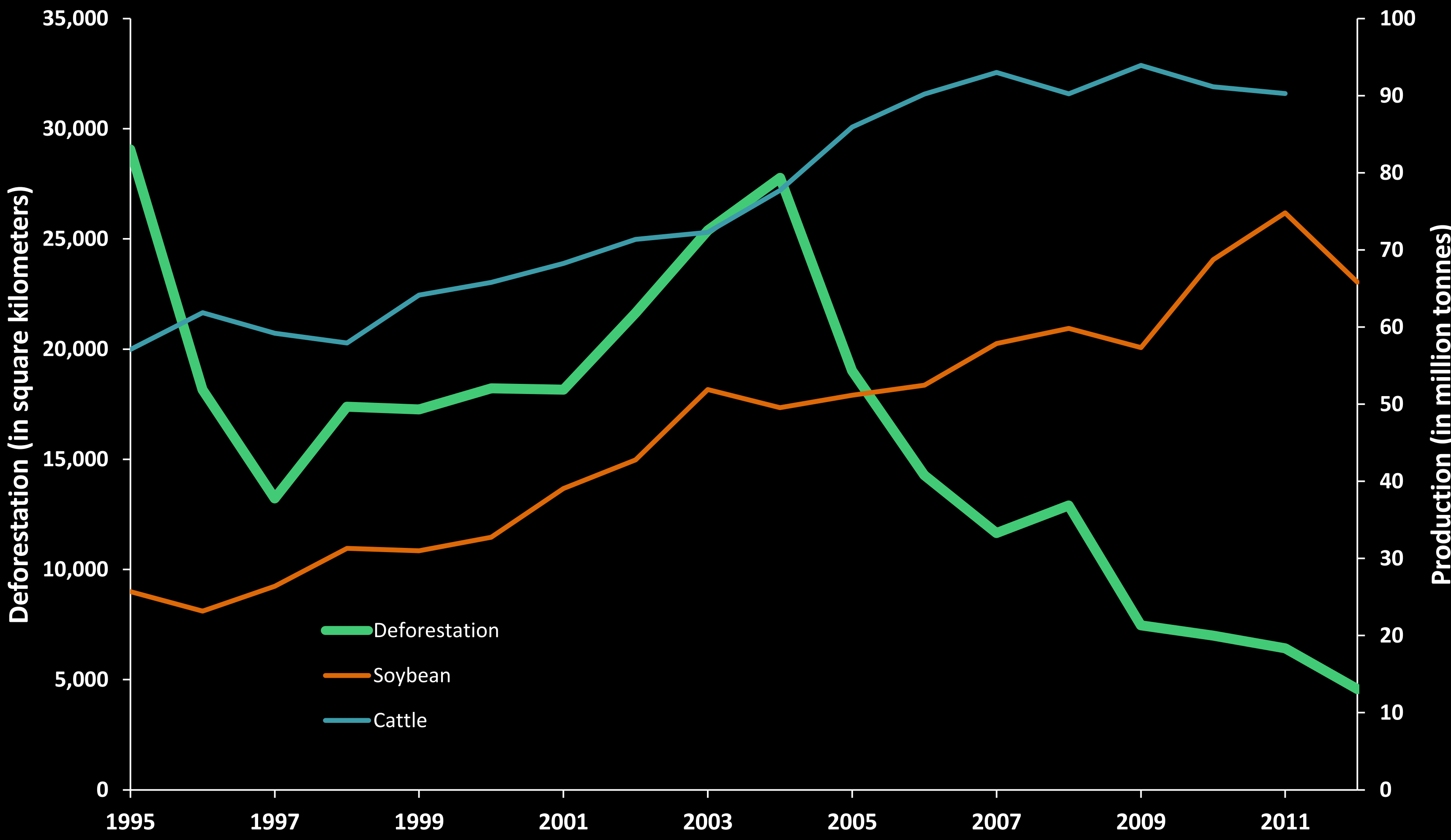
Source: Saenz and Mulligan, Ecosystem Services, 2013.

21%

Brazil has demonstrated that it is possible to reduce deforestation…

Source: Prodes, 2014

…while increasing agricultural production



Source: Prodes, 2014; FAOSTAT, 2014

Value forests for adaptation

Ensure that appropriation of forest resources is legal

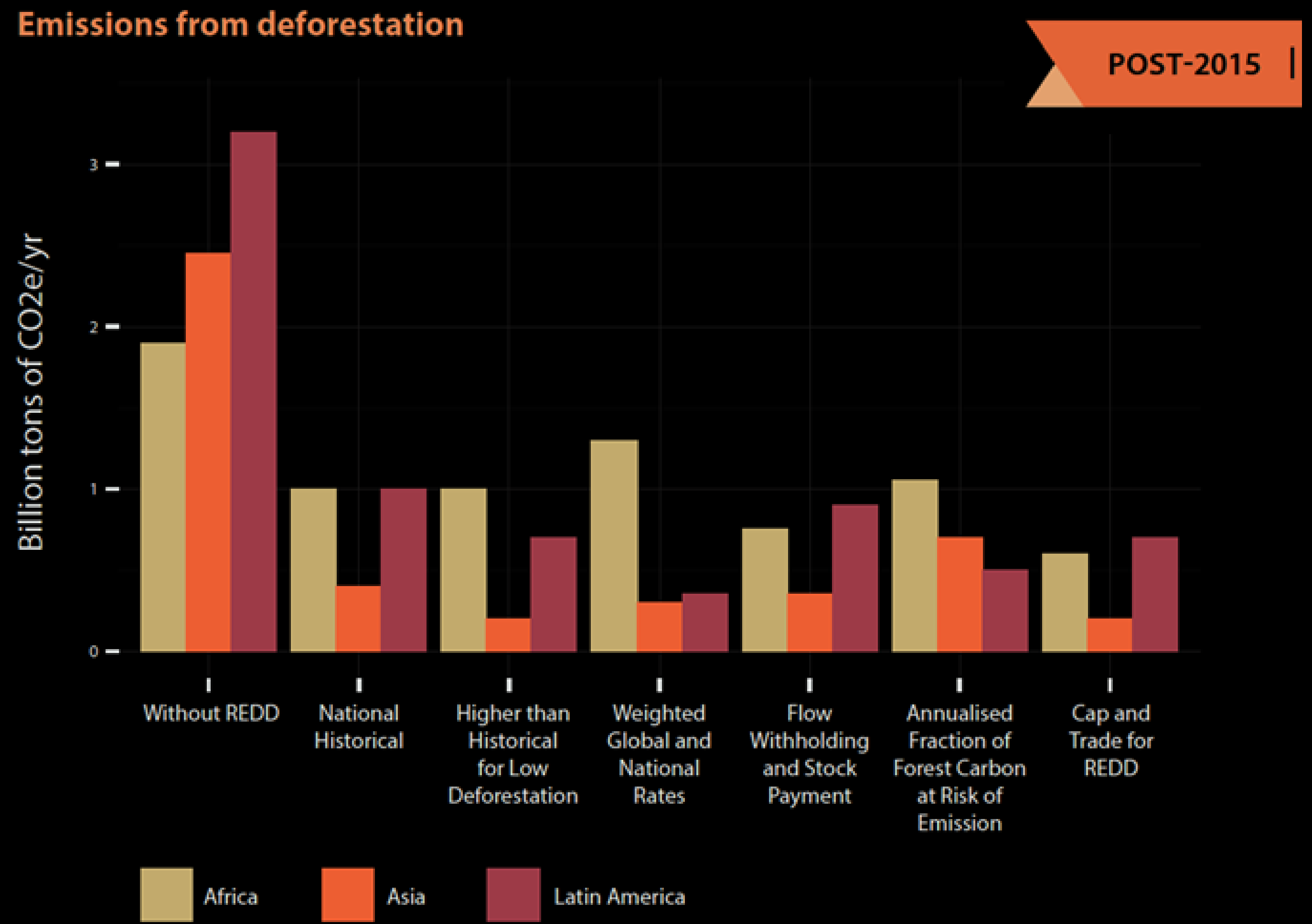
Ensure the equitable distribution of forest benefits

What's the national forest agenda?

- ✓ Include forest-based income in national income accounts
- ✓ Enhance revenues from forests managed as forests
- ✓ Recognize forest-based ecosystem services as an input to agricultural production
- ✓ Recognize conservation of forest-based ecosystem services as cost-effective "green infrastructure"
- ✓ Increase law enforcement effort against illegal logging and forest conversion
- ✓ Recognize and strengthen indigenous and customary forest management systems
- ✓ Understand better the impacts of policies on the distribution of forest-related benefits

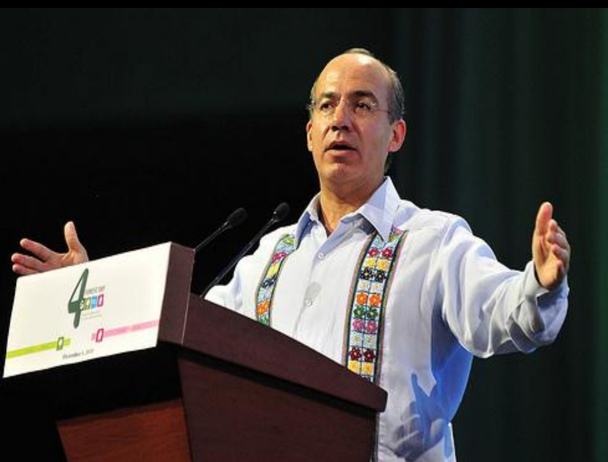
What’s the global forest agenda?

Value forests for climate protection

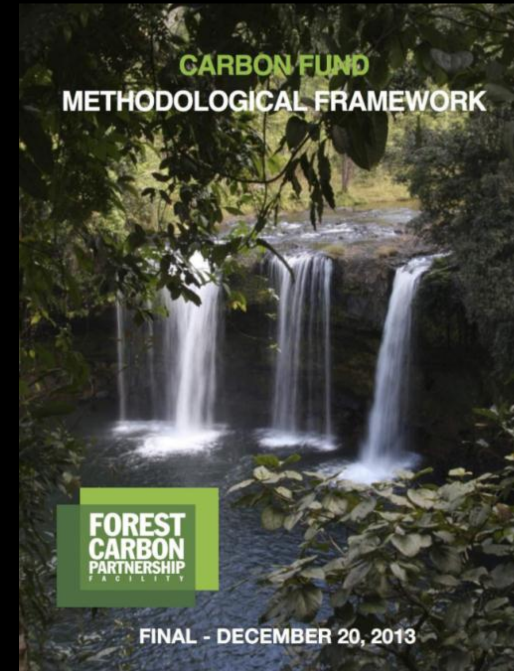


60. Busch, Jonah, et. al. Environmental Research Letters, author calculations (October-December 2009). Available at http://iop-science.iop.org/1748-9326/4/4/044006/fulltext/.

Source: Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda, 2013



2013


CARBON FUND
METHODOLOGICAL FRAMEWORK
FOREST CARBON PARTNERSHIP FACILITY
FINAL - DECEMBER 20, 2013

REDD+

COP15 COPENHAGEN
UN CLIMATE CHANGE CONFERENCE 2009

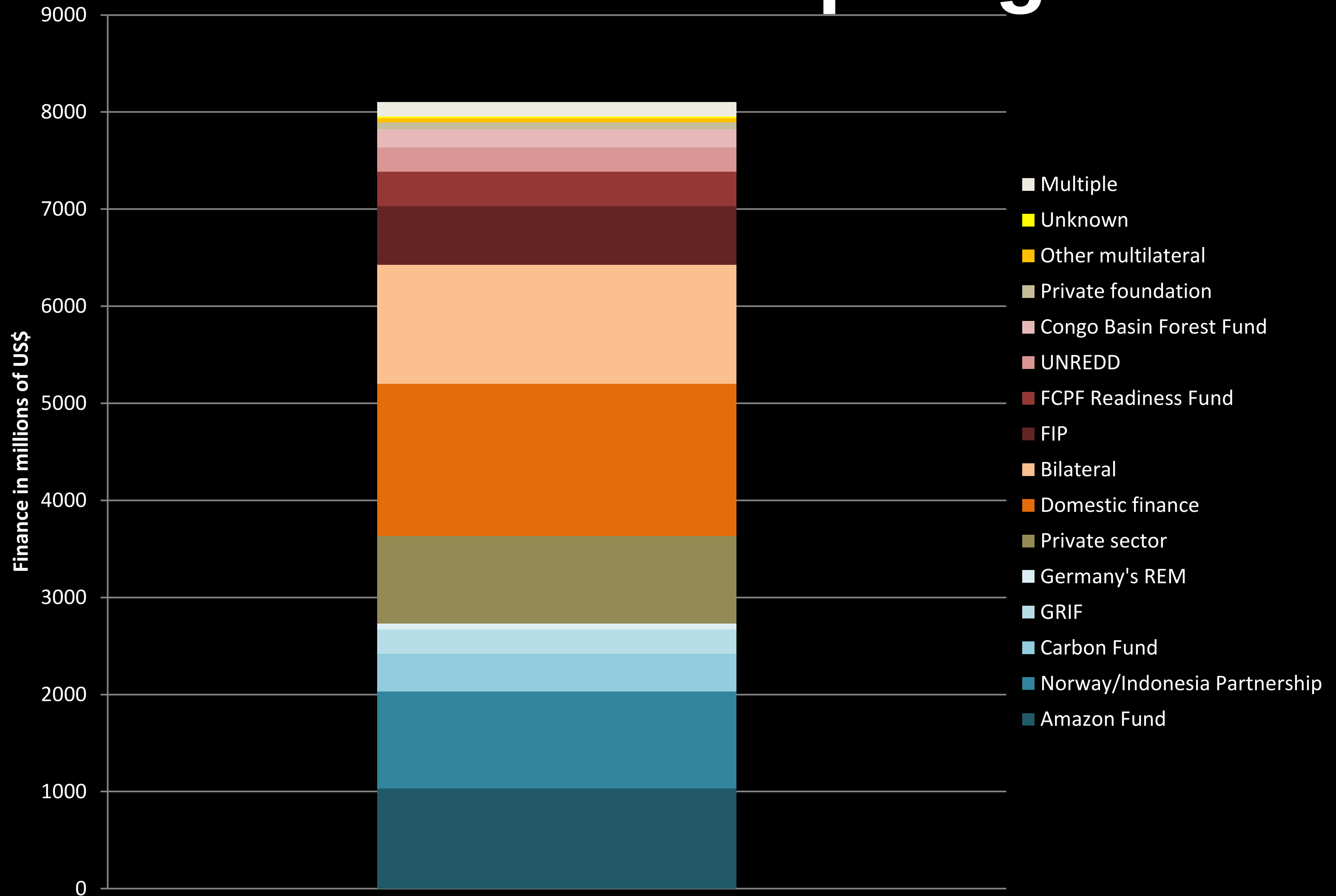
2009

FIP

UN-REDD
PROGRAMME
The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
FAO UNDP UNEP

2007

REDD+ finance pledges



Source: ODI, The State of REDD+ Finance, forthcoming

Support market transformation

gar
agribusiness and food

APP

L'ORÉAL

COLGATE PALMOLIVE®

Kellogg's

Procter&Gamble

Unilever

The Consumer Goods
FORUM
The Global Network Serving Shopper & Consumer Needs

wilmar

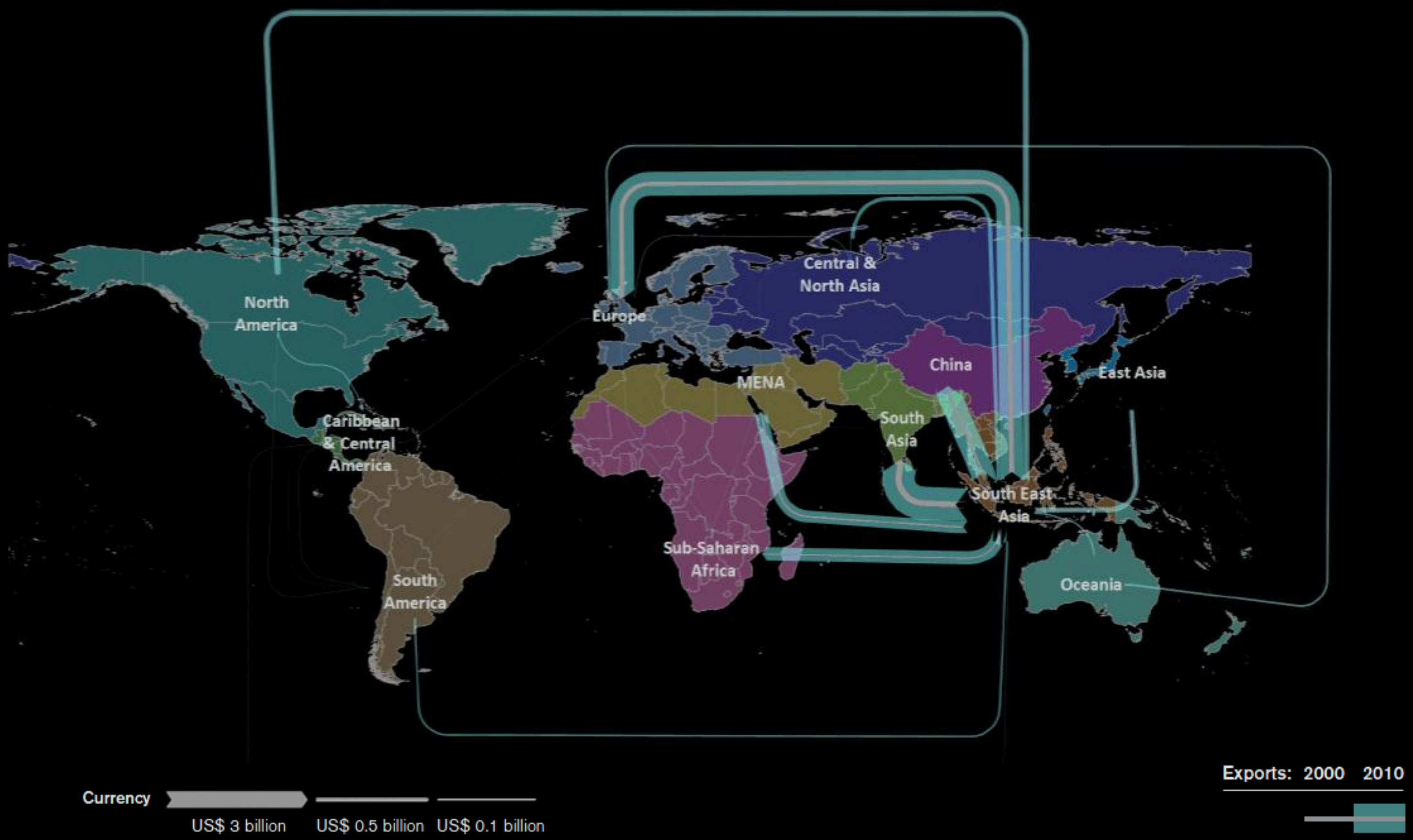
No Deforestation, No Peat, No Exploitation Policy

DECEMBER 5th, 2013

Purpose:

Wilmar International recognizes that while plantation development has contributed significantly to economic development, deforestation and other unsustainable practices have many negative consequences for people and the environment. For that reason, we are working closely with other growers, traders, processors, NGOs, end- user companies, financial institutions and other industry stakeholders to protect forests, peatlands, and human and community rights. To advance this industry transformation, we hereby announce this company policy:

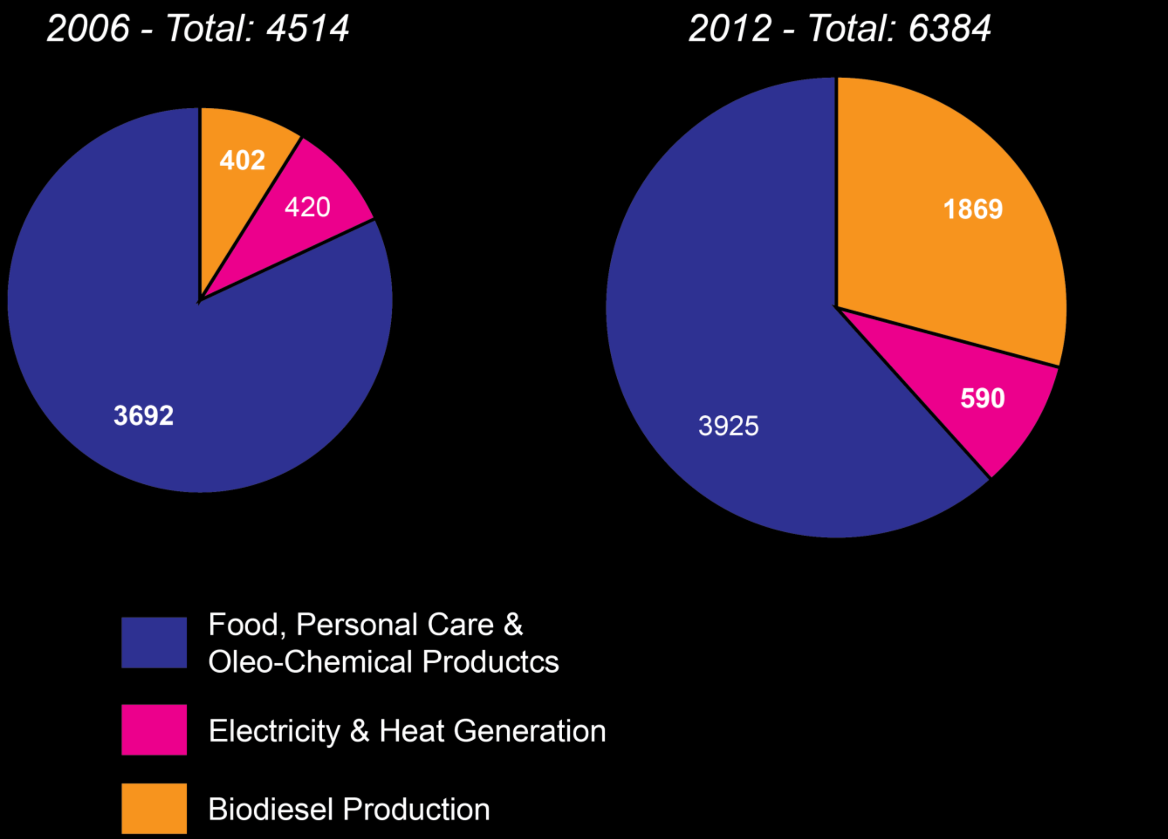
Consumer countries are importing deforestation in globally-traded commodities…



Source: Brack and Bailey (2013) based on Chatham House Resource Trade Database, BACI, COMTRADE.

…and often subsidized by demand-side policies

End Uses of Palm Oil in the EU-27 in 2006 & 2012, Thousand Metric Tons



Data Source: Gerasimchuk and Koh, International Institute for Sustainable Development, 2013.

Employ demand-side tools to transform markets

U.S. Fish and Wildlife Service | **Office of Law Enforcement**

18 USC 42-43
16 USC 3371-3378
Lacey Act

TITLE 18—CRIMES AND CRIMINAL PROCEDURE

CHAPTER 3—ANIMALS, BIRDS, FISH, AND PLANTS

Release date: 2004-08-06

- § 42. Importation or shipment of injurious mammals, birds, fish (including mollusks and crustacea), amphibia, and reptiles; permits, specimens for museums; regulations

TFA 2020

Illegal Logging Prohibition Act 2012

No. 166, 2012

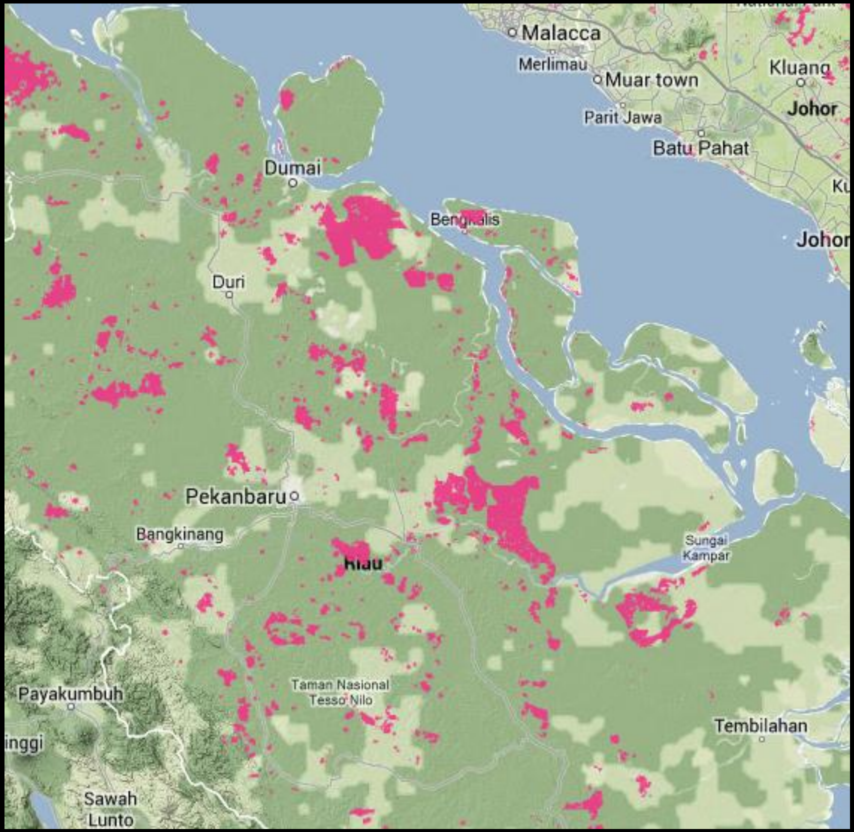
AUSTRALIA

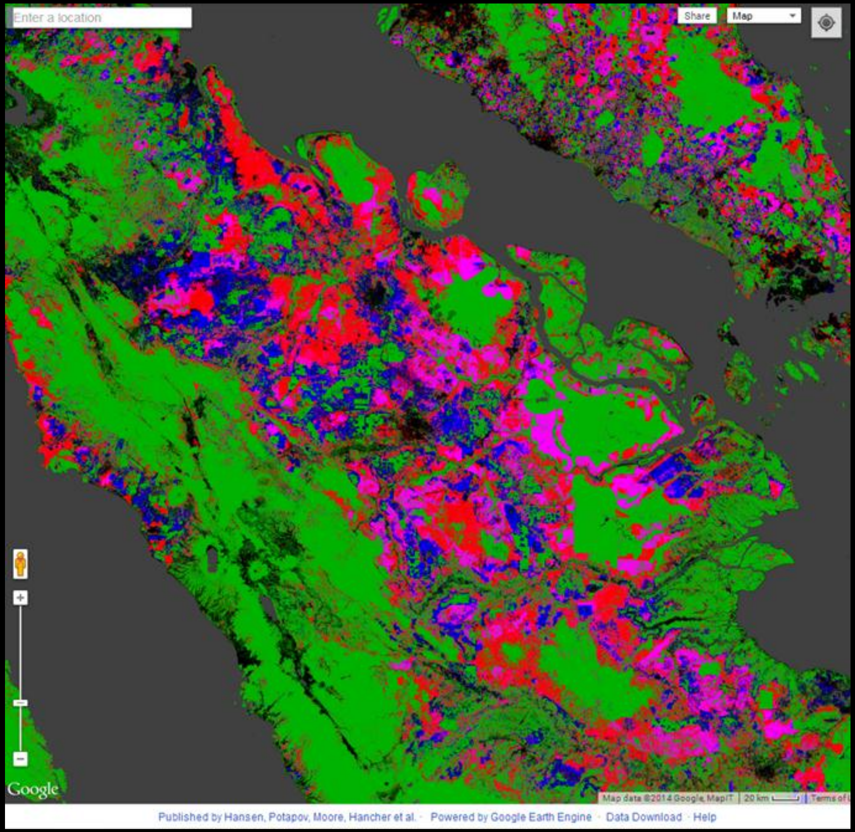
An Act to combat illegal logging, and for related purposes

What's the global forest agenda?

- ✓ Mobilize finance for REDD+ and adaptation
- ✓ Support voluntary private sector commitments to responsible sourcing
- ✓ Remove subsidies for unsustainable biofuels
- ✓ Implement other demand-side policies to provide incentives for legal and sustainable production
  - ✓ Legality assurance initiatives
  - ✓ Green procurement programs

We have succeed in making deforestation visible….






…but the economic costs and benefits of forest loss
– and how they are distributed –
are still invisible

www.cgdev.org
fseymour@cgdev.org
@FrancesJSeymour