



# Overview of forest accounting

*Juan Pablo Castaneda, GENDR, World Bank*

Turkey, March 10, 2015



Wealth Accounting and the Valuation of Ecosystem Services  
[www.wavespartnership.org](http://www.wavespartnership.org)



# Outline

1. The policy agendas at national and global levels
2. Forest accounts in the context of NCA.
3. The accounting framework
4. Filling the tables
5. Where do we get the data from?
6. Valuation
7. A comment on data challenges

# The forest policy agendas



# National agendas

- Enhance revenues from forests managed as forests (REDD+)
- Include forest-based income in national income accounts
- Value forests for food security. Recognize forest-based ecosystem services as input to agriculture.
- Increase forest productivity (green infrastructure)
- Increase forest related activities productivity
- Value forests for adaptation
- Ensure that appropriation of forest resources is legal
- Ensure equitable distribution of forest resources
- Community forest management



# Global agendas

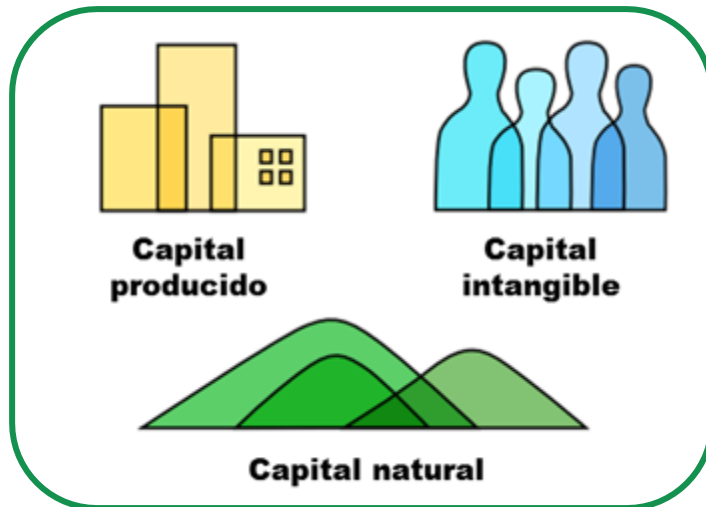
- Mobilize finance for REDD+ and adaptation
- Support voluntary private sector commitments to responsible sourcing
- Remove subsidies for unsustainable biofuels
- Implement other demand-side policies to provide incentives for legal and sustainable production
- Legality assurance initiatives
- Green procurement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

# Forests in the context of NCA

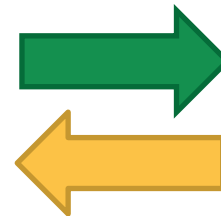


# Why NCA?

## Total wealth



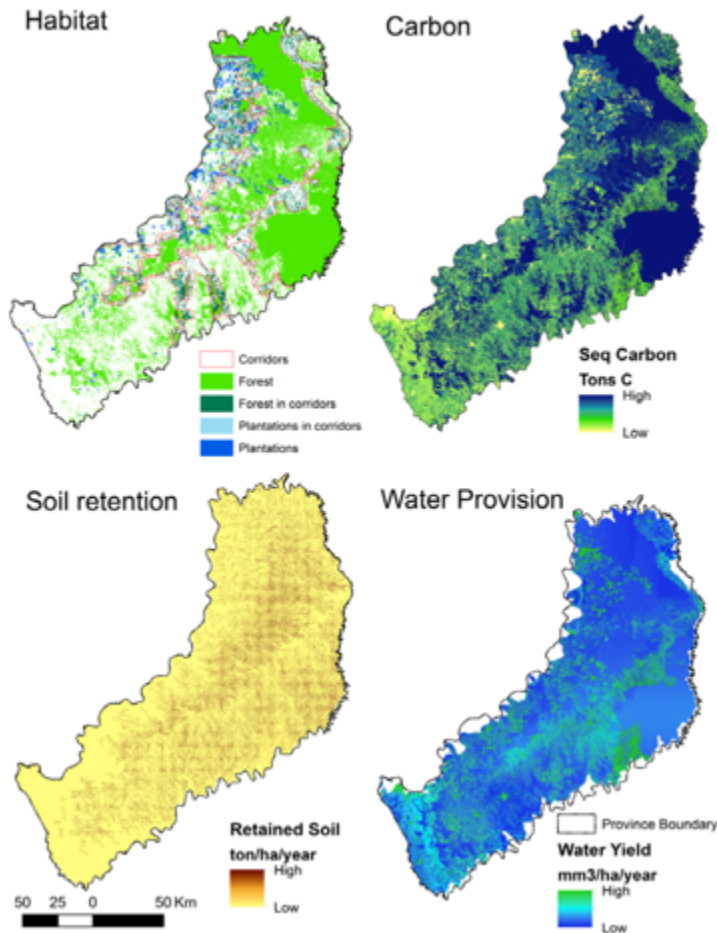
## Flows of capital



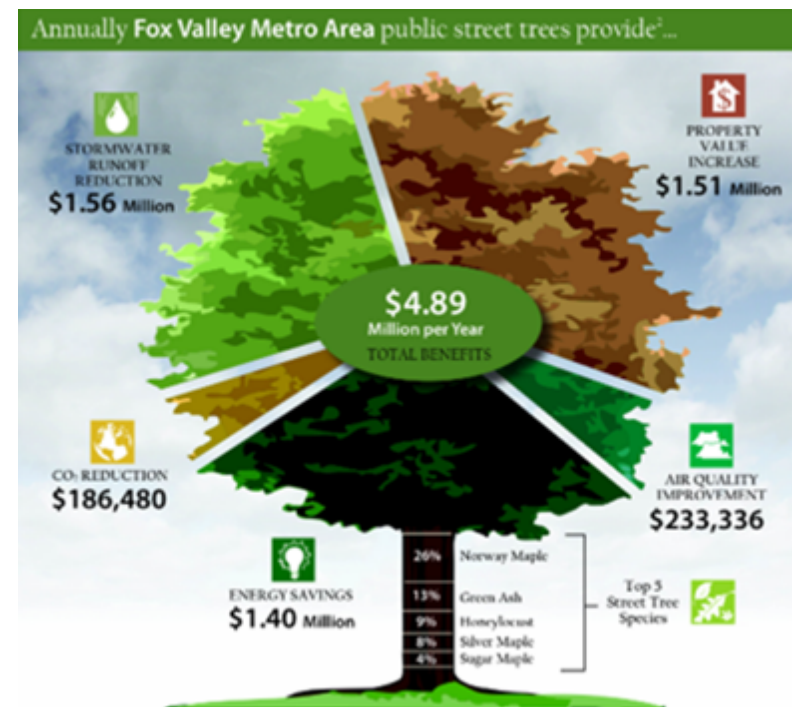
**Benefits  
(Economy)**



# Why forests? Why trees?



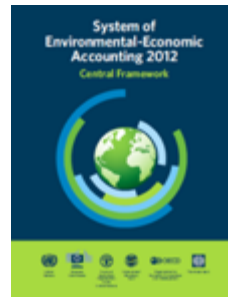
Misiones, Argentina and  
Fox Valley Metro Area, USA





# What do we want to measure and how?

SEEA Central Framework



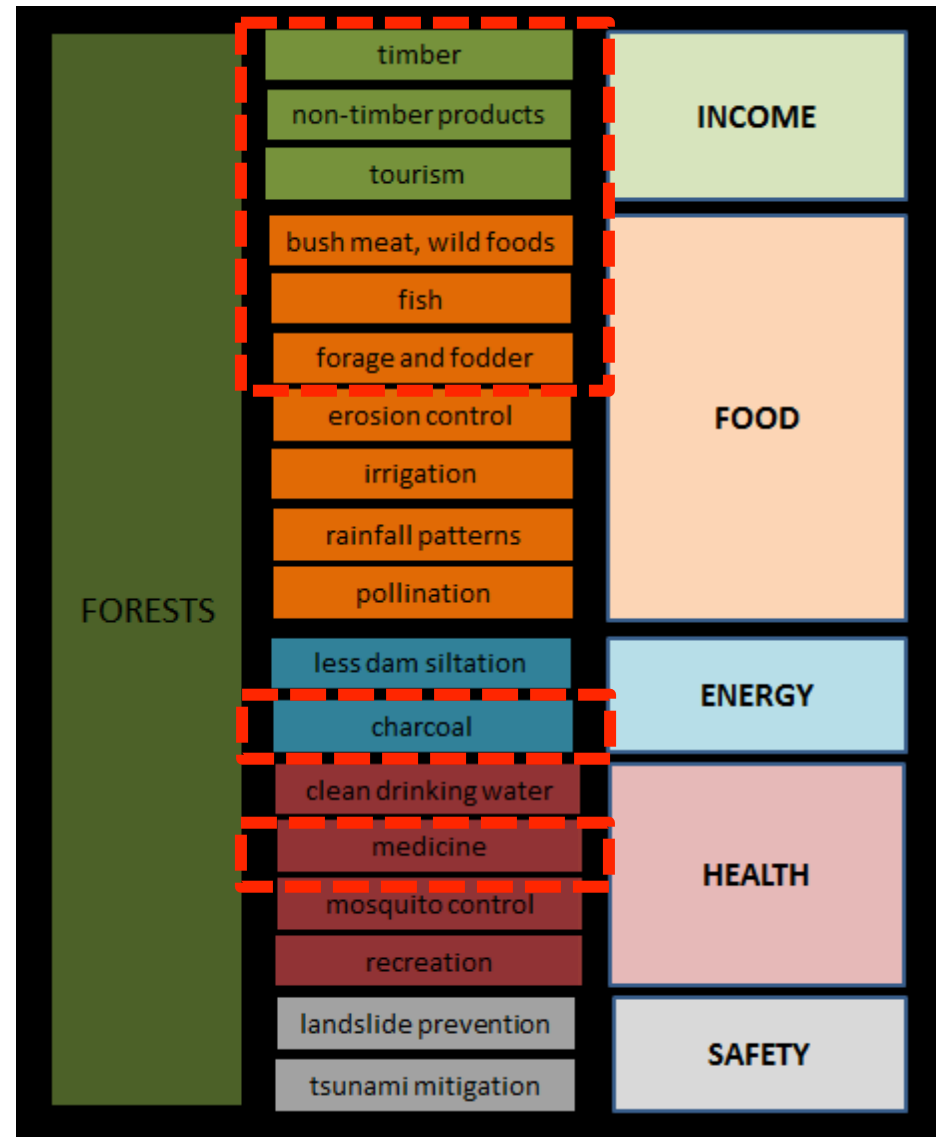
More consensus

Two complementary perspectives



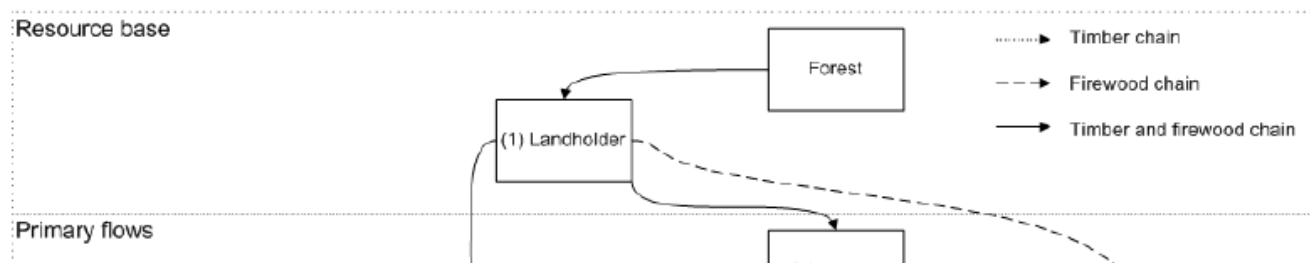
Less consensus

SEEA Ecosystem Accounting



# The accounting framework





Type of logging and primary extraction	Control type, variables, data type and sources						Total logging (t) variables, data types and sources		
	Controlled (c)			Non-controlled (n)					
Clearcutting									
Firewood	FCc	D	INAB data	FCn	R	INAB reports ratio	FC	E	Sum of the parts

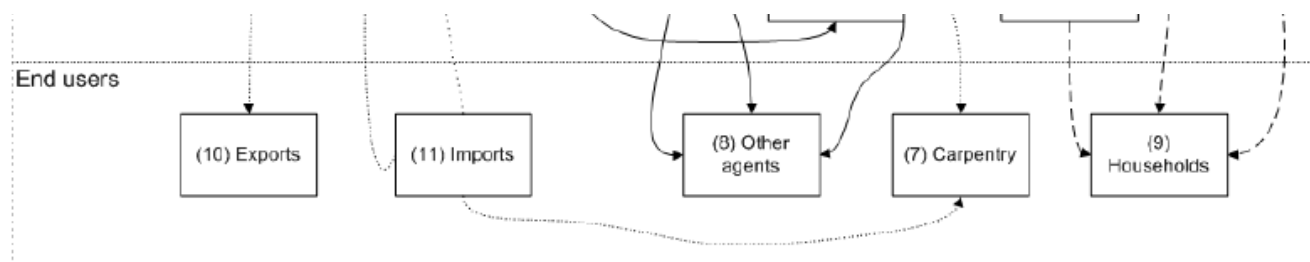
$$L_n = L - L_c$$

$$(C_n + S_n) = (C_t + S_t) - (C_c + S_c)$$

$$[(FC_n + TC_n) + (FS_n + TS_n)] = [(FC_t + TC_t) + (FS_t + TS_t)] - [(FC_c + TC_c) + (FS_c + TS_c)]$$

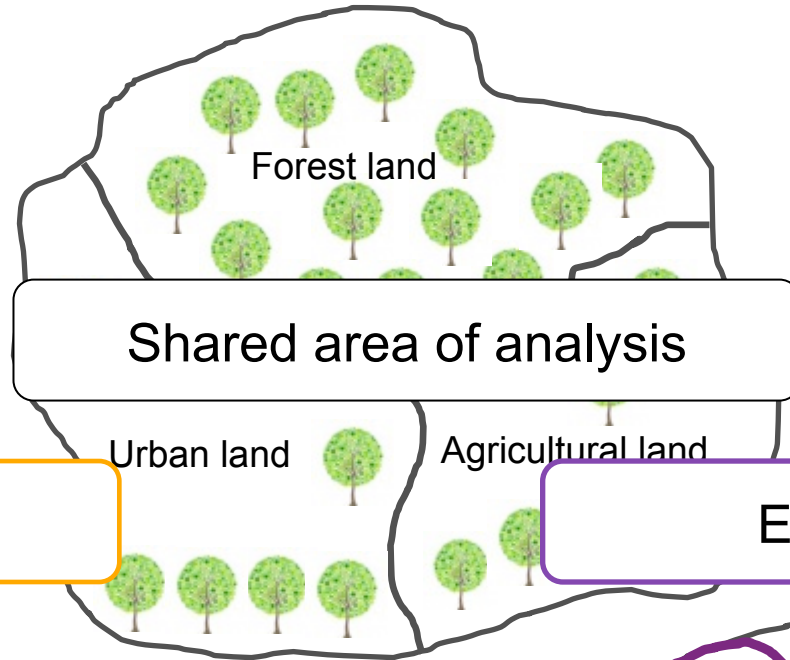
$$F_n + T_n = F_t + T_t - F_c + T_c$$

D = Direct source, O = Own estimations (survey, interview or gis), E = Estimated as residual from identity or as the sum of the parts, R = Ratios obtained from direct sources

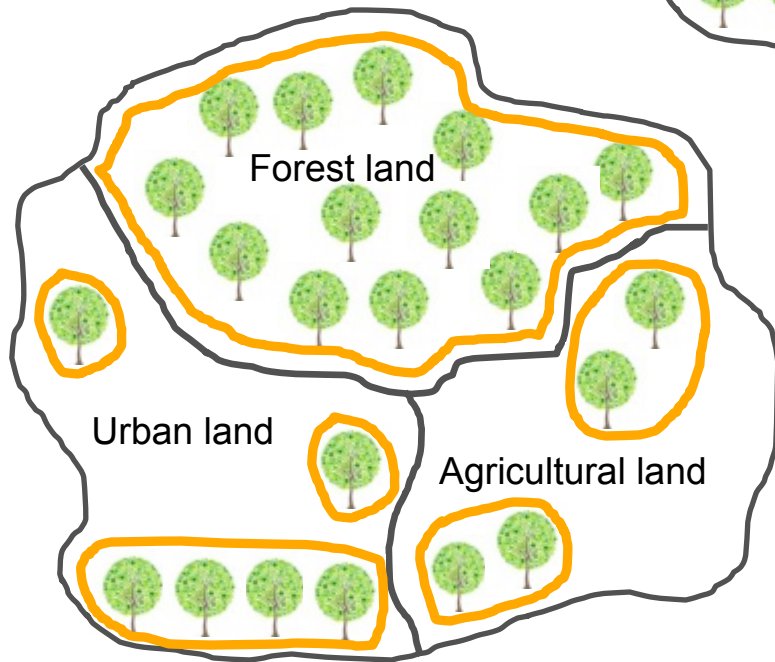


# The framework

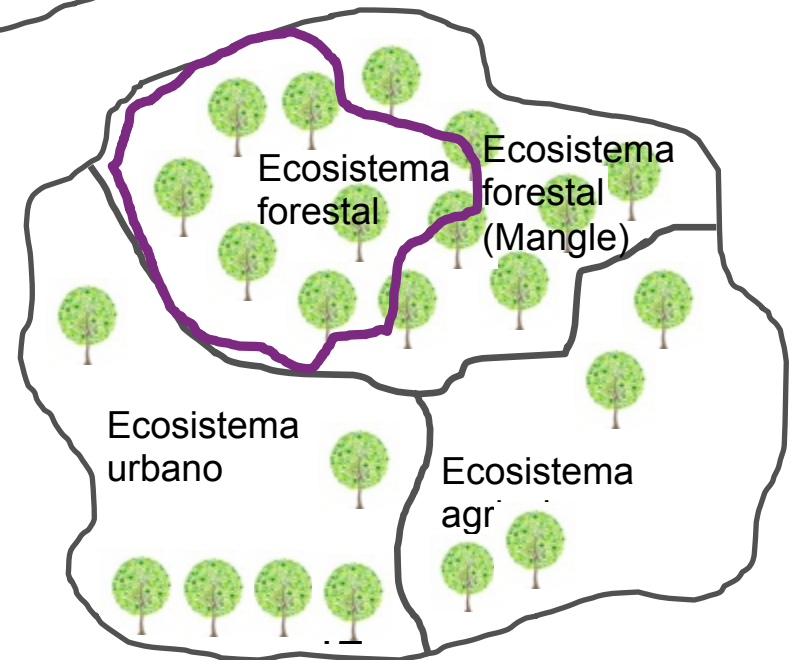
- Land cover types
- Scope of the ecosystem based forest account
- Scope of the resource based forest account



Individual resources



Ecosystems



# General structure of the forest accounts – ASSET ACCOUNTS

❖ resource by resource

Type of timber resource		
Natural timber resources		
Cultivated timber resources	Available for wood supply	Not available for wood supply

Monetary units

Type of timber resources	
Cultivated timber resources	Natural timber resources Available for wood supply

**Opening stock of timber resources**

**Additions to stock**

Natural growth

Reclassifications

*Total additions to stock*

**Reductions in stock**

Removals

Natural losses

Catastrophic losses

Reclassifications

*Total reductions in stock*

**Closing stock of timber resources**

❖ Cultivated: management practices constitute a process of economic production

❖ Natural: where the previous doesn't apply.

❖ Not AFWS: due to physical, economic or regulatory reasons

❖ forest asset (forest ecosystem unit)

Monetary units

	Changes of ecosystem condition				
	Vegetation	Biodiversity	Soil	Water	Carbon
Opening condition					
Improvements in conditions					
Reduction in condition					
Closing condition					

**Opening stock**

**Additions to stock**

Regeneration-natural

Regeneration. human

*Total additions to stock*

**Reductions in stock**

Extraction and harvest

Catastrophic losses

*Total reductions in stock*

Revaluations

**Closing stock of ecosystem assets**

EAU or LCEU

## General structure of the forest accounts – FLOW ACCOUNTS

**Table 6.9: Physical supply and use table for wood products, France, 1999**  
(timber, logs and wood in 1000 cubic metres; pulp, paper and waste in 1000 tons)

The diagram illustrates the flow of materials and products through three main stages: **SUPPLY**, **USE**, and **WASTE**.

- SUPPLY** (Economic activities: suppliers):
  - Products** (Physical Units): A vertical list of products including 90920, 23162, 31200, 11869, and others.
  - Monetary Units**: A table showing aggregated values for various products, with columns for 'Physical Units' and 'Monetary Units'.
- USE** (Economic activities: intermediate and final consumers):
  - Products** (Physical Units): A vertical list of products including 23337, 10944, 7736, 4372, 2265, 5276, and others.
  - Monetary Units**: A table showing aggregated values for various products, with columns for 'Physical Units' and 'Monetary Units'.
- WASTE** (Economic activities: waste management):
  - Products** (Physical Units): A vertical list of products including 1276, 375, 1624, 2695, 431, 4167, 980, 1028, and others.
  - Monetary Units**: A table showing aggregated values for various products, with columns for 'Physical Units' and 'Monetary Units'.

Arrows indicate the flow of materials and products from **SUPPLY** to **USE** and **WASTE**, and from **USE** to **WASTE**.

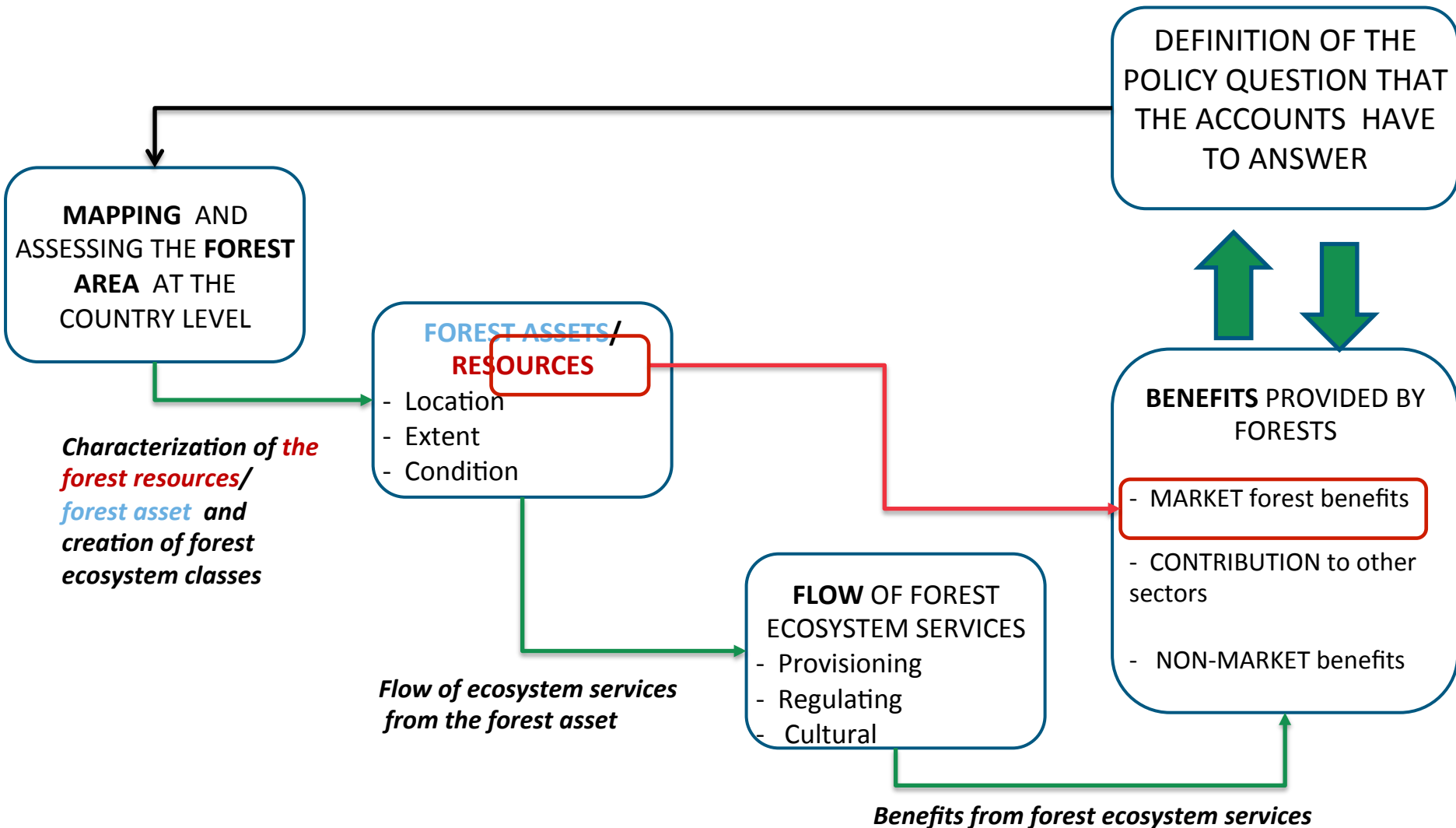
Services	Suppliers				
	Consumers				

# Filling the tables





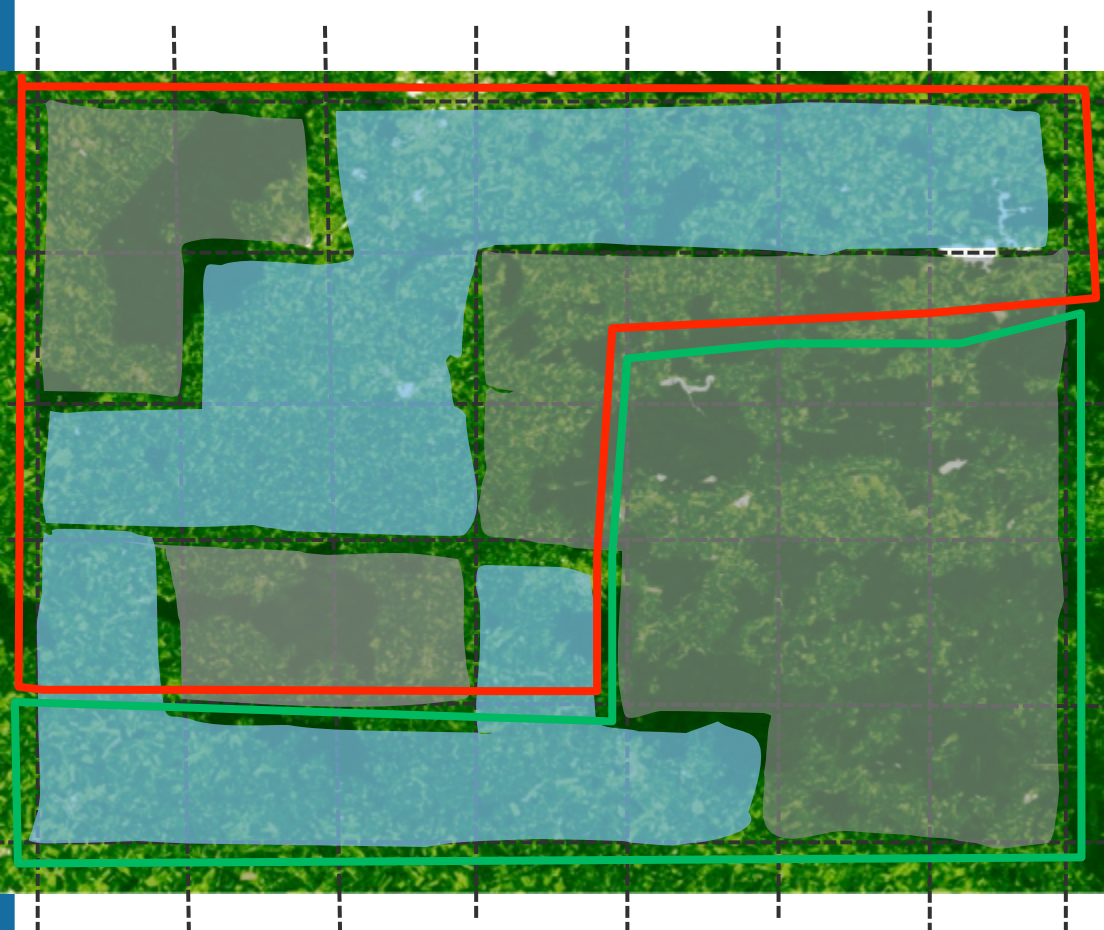
# General steps to compile the accounts



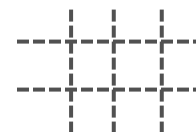
# Mapping of the forest area & ecosystems

Steps proposed by the EEA to define units to account for forest assets



- Basic Statistical Units





BSUs: Basic Statistical Units  
Min grid resolution info



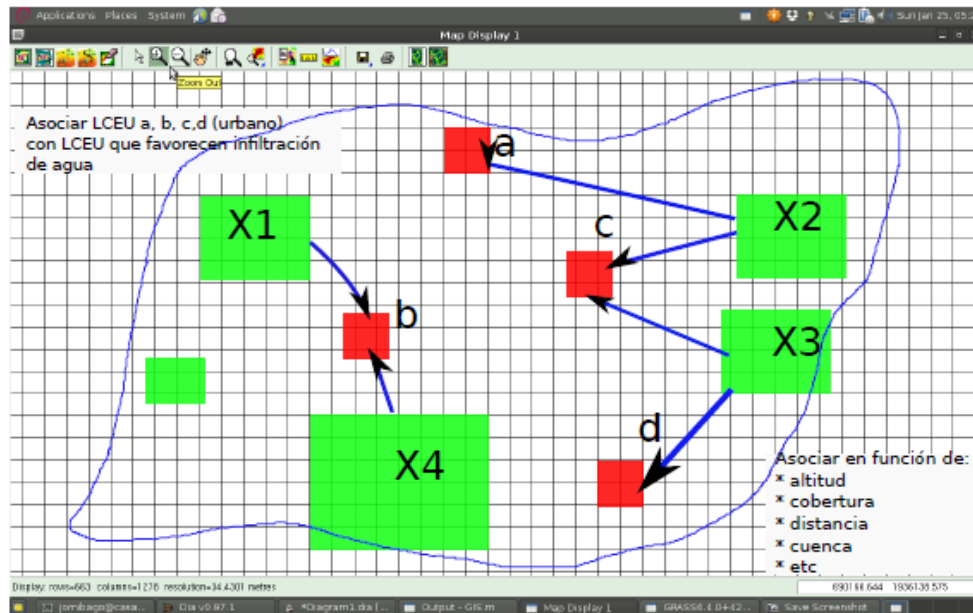
LCEUs Closest to ecosystems

-  Broadleaved primary forest
-  Broadleaved secondary forest

EAUs Long-term monitoring

-  Not protected forest
-  Natural park (protected forest)

# Spatial relationships between BSU



hacia	desde	flujo
a	X2	f1
b	X1	f2
b	X4	f3
c	X2	f4
c	X3	f5
...	...	...

$$\text{Flujo total} = \sum \text{flujo}$$

Flujo hacia a = *select sum(flujo) from table where hacia=a*

Flujo desde X1 = *select sum(flujo) from table where desde=X1*

# Indicators to characterize the forest ASSET

## Forest land

Opening stock of forest and other wooded land	
Additions to stock	
<ul style="list-style-type: none"> <li>Afforestation</li> <li>Natural expansion</li> <li>Reforestation</li> </ul>	<ul style="list-style-type: none"> <li>Afforested area (m<sup>2</sup>)</li> <li>Density (trees/ha)</li> <li>Area (m<sup>2</sup>)</li> <li>Reforested area (m<sup>2</sup>)</li> <li>Density (trees/ha)</li> </ul>
Reductions in stock	
<ul style="list-style-type: none"> <li>Deforestation</li> <li>Natural regression</li> </ul>	<ul style="list-style-type: none"> <li>Deforested area (m<sup>2</sup>)</li> <li>Area (m<sup>2</sup>)</li> </ul>
Closing stock of forest and other wooded land	

## Standing timber

Additions to stock	
<ul style="list-style-type: none"> <li>Growth</li> <li>Timber in young trees (not considered in previous accounting period)</li> </ul>	<ul style="list-style-type: none"> <li>Natural growth of timber volume (m<sup>3</sup>)</li> <li>Volume in trees recently classified as timber (m<sup>3</sup>)</li> </ul>
Reductions to stock	
<ul style="list-style-type: none"> <li>Tree harvest</li> <li>Tree losses</li> </ul>	<ul style="list-style-type: none"> <li>Harvested timber during the period (m<sup>3</sup>)</li> <li>Losses in timber volume due to fires, disease, catastrophic events, etc (m<sup>3</sup>)</li> </ul>
Closing stock of standing timber	

## Condition of forest ecosystems

Defoliation	<ul style="list-style-type: none"> <li>Litter fall measurements (kg)</li> <li>LAI-based indicator</li> </ul>
Forest health	<ul style="list-style-type: none"> <li>Presence of pathogens and plagues</li> <li>Status of bark</li> <li>Mortality rate</li> </ul>
Forest fires	<ul style="list-style-type: none"> <li>Burnt area</li> </ul>
Fragmentation	<ul style="list-style-type: none"> <li>% of forest area in categories (core, interior, connected, patchy)</li> <li>Effective mesh size</li> <li>Size of forest fragments</li> <li>Length of fragment edge</li> </ul>
Aerosol pollutants	<ul style="list-style-type: none"> <li>Ozone concentration</li> <li>Nitrogen deposition</li> <li>Sulfur deposition</li> </ul>

# Indicators to characterize the forest FLOWS

## Provisioning services

- Timber
  - Harvested timber (m<sup>3</sup>; m<sup>3</sup>/ha)
- Firewood/charcoal
  - Volume ( m<sup>3</sup>)
- NTFP
  - Volume ( m<sup>3</sup>); Weight (kg; ton); Number of units
- Genetic material
  - Composition
  - Diversity
- Grazing
  - Number of animals in silvo-pastoral system
  - Weight units of produced animal product
  - Energy uptake

## Regulating services

- Atmospheric/climate regulation
  - Net carbon storage (gains-losses)
- Water flow regulation
  - Canopy cover fraction in recharge areas
  - Average daily and annual water flow in rivers
  - Cover in strategic locations (floodplains, steep slopes, wetlands, etc)
- Water cycle regulation
  - BOD
  - Turbidity in waterways
- Pollination
  - Abundance and variety of pollinator species
- Soil retention and formation
  - Erosion rates
  - Cover (or bare soil) fraction in vulnerable areas
  - Turbidity in waterways

## Cultural services

Division	Group	Class	Indicators
Physical and intellectual interactions with biota, ecosystems, and land-/seascapes	Physical and experiential interactions	Experiential use of plants, animals and land-/seascapes in different environmental settings. And physical use of land-/seascapes in different environmental settings	<ul style="list-style-type: none"> <li>• Distribution of wildlife/emblematic species associated with forest</li> <li>• Important bird areas associated with forest</li> <li>• Area of forest accessible for recreation</li> <li>• Number of visitors</li> <li>• Number of hunters</li> <li>• Ecotourism operators</li> <li>• Area of forests accessible for hunting</li> </ul>
	Intellectual and representative interactions	Scientific, educational, heritage, cultural, entertainment and aesthetic	<ul style="list-style-type: none"> <li>• Citations, distribution of research projects, educational projects, number of historic records</li> <li>• Number/value of publications sold</li> </ul>
Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes	Spiritual and/or emblematic	Symbolic and sacred and/or religious	<ul style="list-style-type: none"> <li>• Distribution of sites of emblematic plants/forest</li> <li>• Number of sites with recognised cultural &amp; spiritual value</li> <li>• Number of visitors</li> </ul>
	Other cultural outputs	Existence and bequest	<ul style="list-style-type: none"> <li>• Distribution of important areas for forest biodiversity and their conservation status</li> <li>• Condition of forest-associated priority species on habitat and birds directives</li> <li>• Distribution of sites with forest designated as having cultural values</li> <li>• Number of visitors</li> </ul>

# Where do we get the data from?

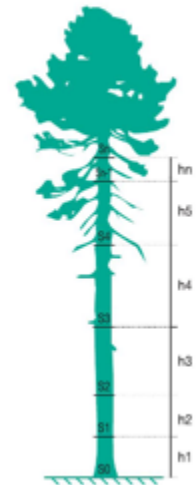
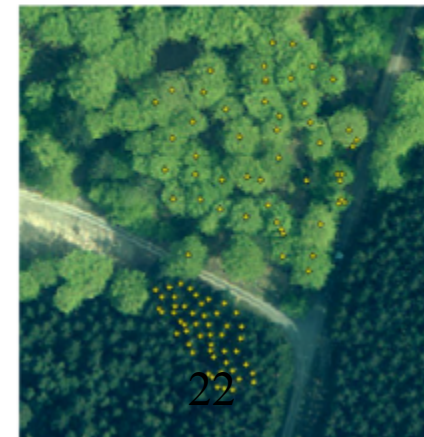
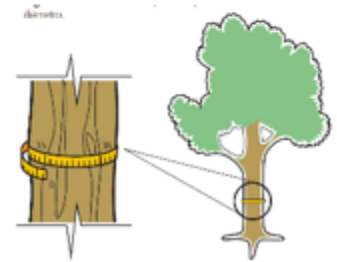
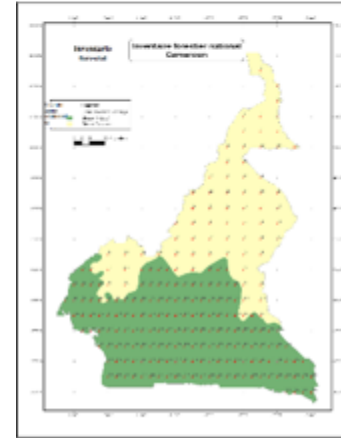


# Where do we get the data from?

## Forest inventories/forest statistics

Main features:

- ❖ The primary source of quantitative information on forest resources
- ❖ Based on statistical sampling
- ❖ Based on field surveying techniques
- ❖ Basis for planning and assessments at country, regional or global level (e.g. Forest Resources Assessment – FRA)



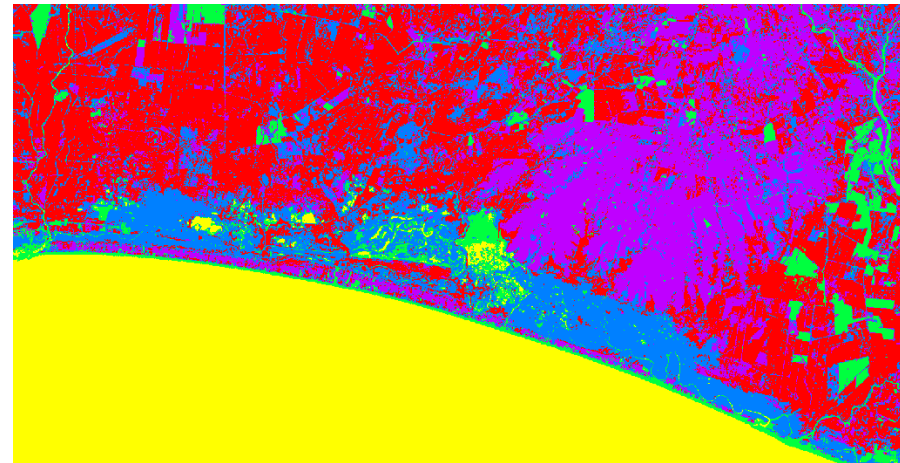


# Where do we get the data from?

## Spaceborne remote sensing

### Why remote sensing?

- ❖ Dynamic data source of area covered by vegetation
- ❖ Identification of different vegetation types
- ❖ Upgrade forest inventories
- ❖ Information forest condition
- ❖ Geographical reference
- ❖ Constant technological development

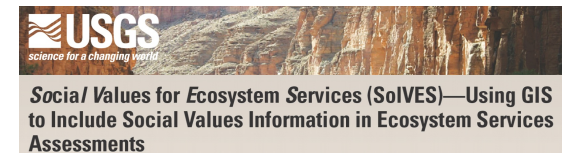


Example: Land cover classification based on Landsat 8 imagery. Pacific coast; Guatemala

# Forest Modeling

## Why modeling ?

- ❖ Various indicators of forest assets and flows can not be measured directly.
- ❖ Particularly useful for deriving indicators of environmental services.
- ❖ Some examples are:
  - Wild fauna population
  - Erosion protection
  - Surface discharge
  - Carbon sequestration
  - Green area deficit in urban areas



## Other sources

- ❖ Livelihood surveys
- ❖ Population census
- ❖ Other statistics, reports, spatial databases
- ❖ etc.
- ❖ SNA → validate
- ❖ Global forest

watch (?)

**Table 6.** Number of households in survey consuming each type of renewable energy.

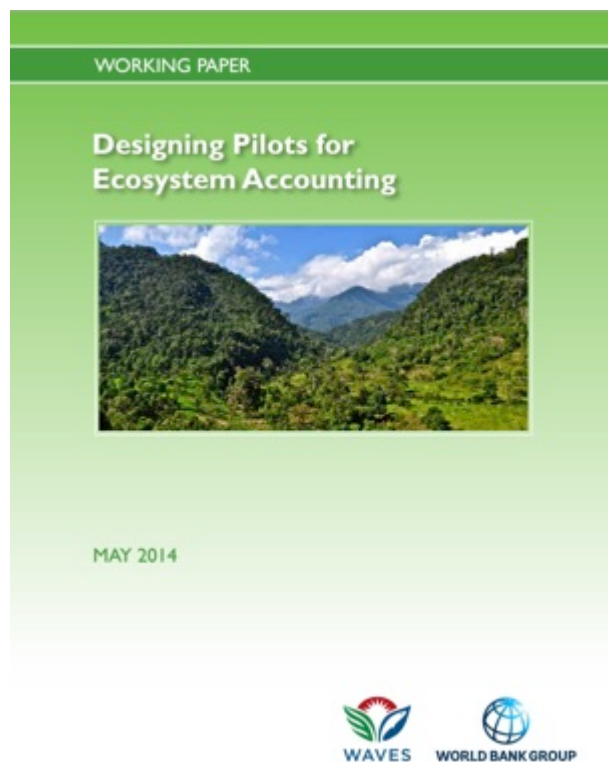
Village class	Sample size	Fire-wood	Char-coal	Plant residues	Animal dung	Biogas	Solar panel
LOA	406	395	35	250	40	0	0
LOF	276	275	29	192	10	0	1
RAF	29	29	5	25	1	0	0
UPA	37	37	7	22	0	0	0
LOG	162	147	83	115	5	1	0
UG	351	202	248	324	3	0	0
National total	1261	1085	407	928	59	1	1

Source: Mustonen, S.; Raiko, R.; Luukkanen, J. Bionergy consumption and biogas potential in Cambodian households. Sustainability. 2013 (5) 1875-1892 doi:10.3390/su5051875 25

# Valuation



# What type of valuation?



<https://www.wavespartnership.org/sites/waves/files/documents/PTEC2%20-%20Ecosystem.pdf>

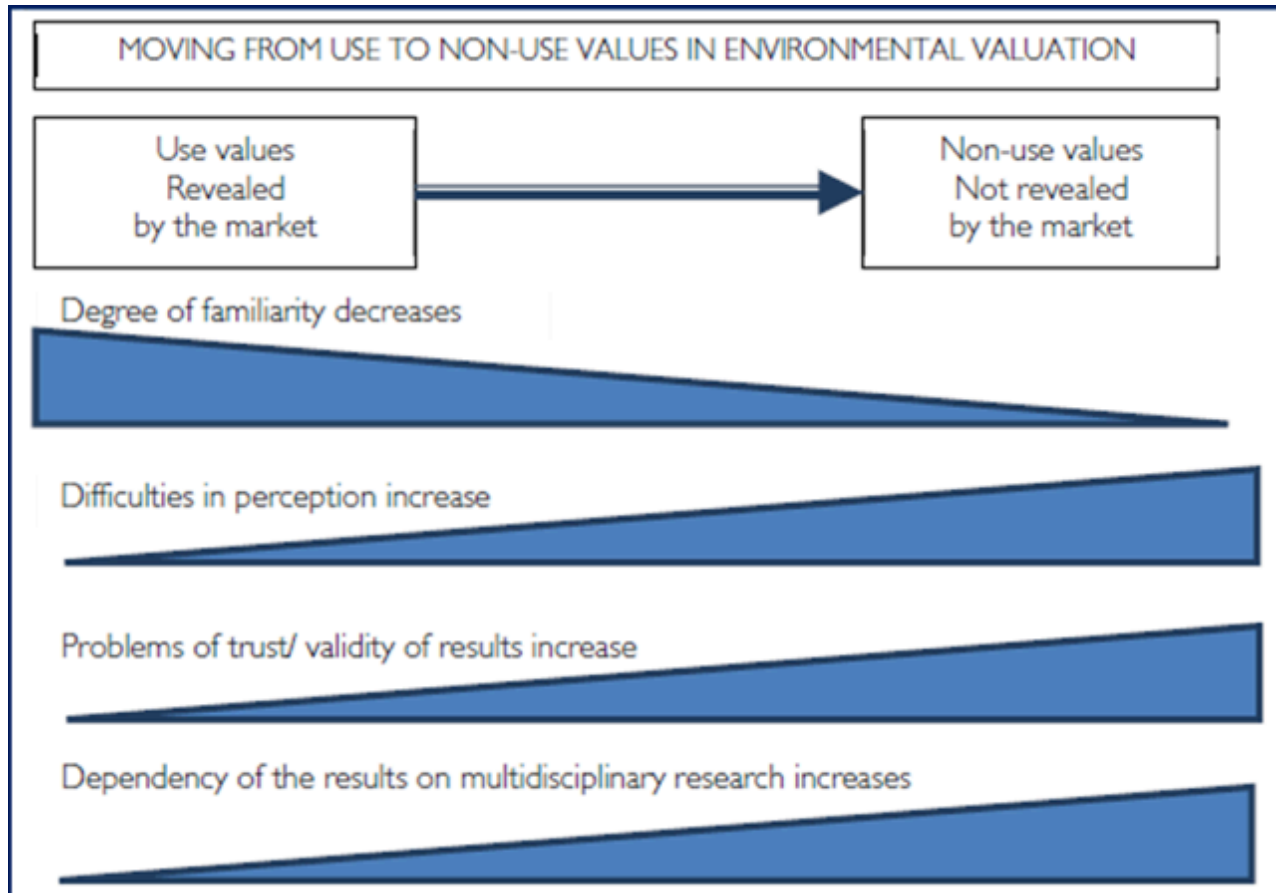
Type of Ecosystem Service	Valuation Method	Short Description
Provisioning services	Unit resource rent	Producer's surplus is calculated net of labor and man-made capital inputs and adjusted for taxes and subsidies. The value will vary depending on the associated structure of property rights. In the case of open access, it is important to include calculations for different institutional settings, to understand the potential value of the service.
Regulating services	Production function method	The contribution of ecosystem services to production processes are valued by estimating their contribution to the value of the final product when sold on the market (i.e., net of labor and capital costs).
	Damage costs	The value of production losses or damages due to degradation or loss of ecosystem services can be used as estimates of the value of these services.
Cultural services	Travel cost method	The amount that consumers are willing to pay for goods and services related to visits to recreational sites can be used as a proxy for the value of the ecosystem and its attributes.
	Hedonic pricing	This involves disentangling the part of the price that people pay for marketed products or assets that can be attributed to the local ecosystem services.
	Production function	Similar to regulating services, the value of cultural services can be disentangled from the value of marketed products. An example is to estimate the part of the value added of the tourism sector that can be attributed to the ecosystem.

# Main principles

Not to include consumer surplus in the valuation of ecosystem services. However, it is appropriate to use the change in consumer surplus (=price) times quantity, since this will provide a marginal price. The production function approach or damage costs avoided approach are suitable methods to use.



# Credibility is the key to valuation?



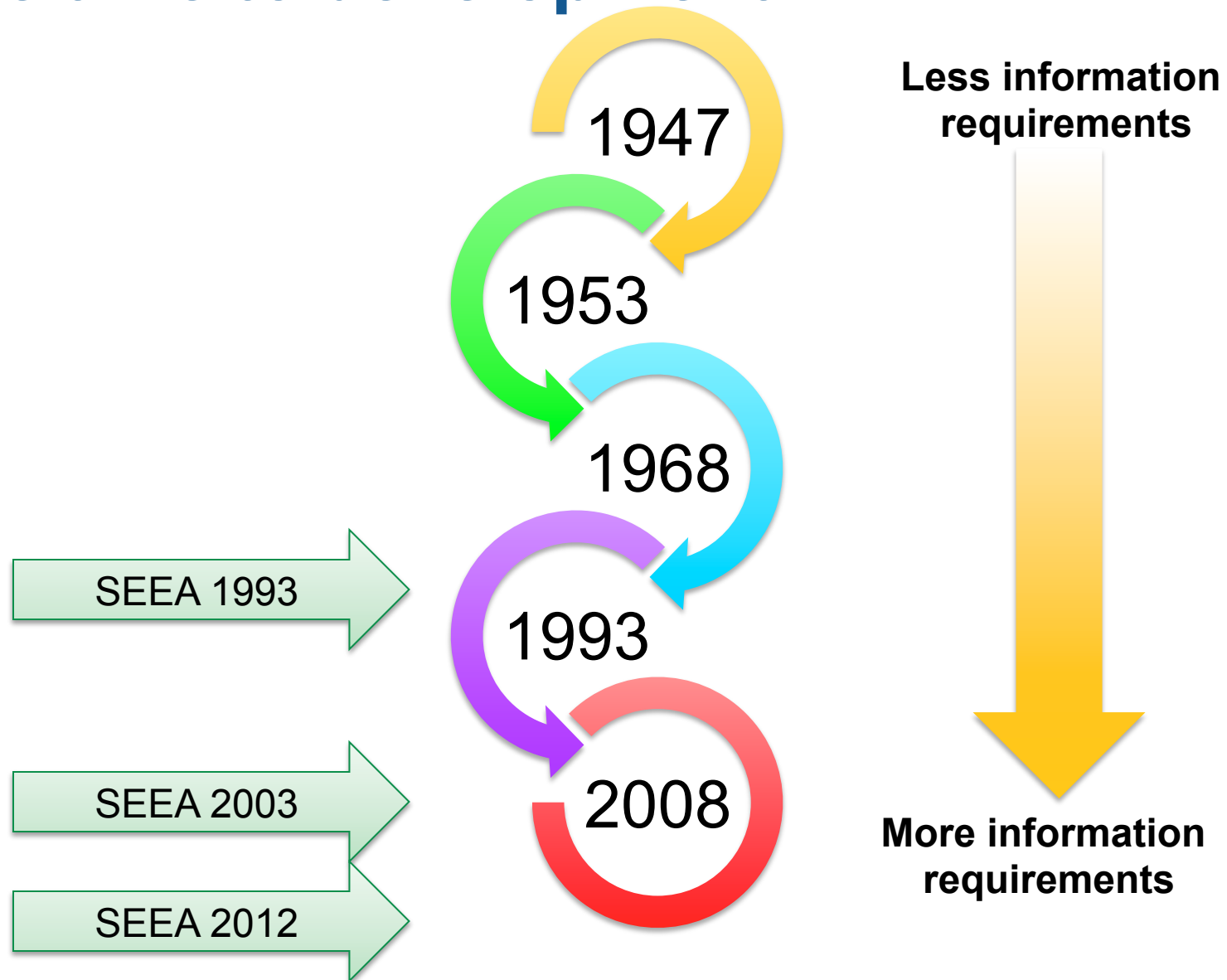


# A comment on data challenges

Based on Seymour, 2014



# Give time to development...



## Information on forests has never been better...

## REPORTS

17. T. Cernai, R. Abhar, *Arch. Iran. Geol.* **28**, 127-134 (2005).
18. A. A. Makarewicz et al., *Col. J. Sci.* **124**, 109-109 (2006).
19. A. A. Makarewicz et al., *Geol. Iran.* **43**, 167-168 (2006).
20. I. Macho, A. Khatami, J. G. Roques, R. S. Khatami, *Science* **315**, 1050-1051 (1999).
21. Manuscripts and materials are available as supplementary materials on Science Direct.
22. Q. Zhu, C. S. Elman, Y. R. Khatami, A. A. Makarewicz, *Geochimica et Cosmochim. Acta* **71**, 1017-1171 (2007).
23. M. Steinhilber, S. Steinhilber, *Proc. Natl. Acad. Sci.* **104**, 10707-10712 (2007).
24. J. Jorka, *Repositor Repert.* **13**, 175 (2002).
25. V. V. Khatami, J. Jorka, *Trans. Geol.* **28**, 52-57 (2005).
26. S. Khatami, M. A. Lee, C. T. Wu, *Geochimica et Cosmochim. Acta* **71**, 1967-1977 (2007).
27. Q. Zhu, Z. Baoxing, *Science* **315**, 1045-1050 (2006).
28. C. T. Grant, L. J. Bailey, R. S. Noble, *Radiochim. Acta* **77**, 101-112 (2005).
- Acknowledgments** This work was funded by Iran's Ministry of Science, Research and Technology and a Postdoctoral Fellowship to D.R. and a 10% postdoctoral fellowship to A.A. All the sequencing data generated in this study are available in the GenBank database. The authors thank the staff of the National Center for Genome Information (NCGI) at the University of Maryland for their assistance in sequencing.

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

M. C. Hansen,<sup>1,2</sup> P. V. Potapov,<sup>1</sup> R. Moore,<sup>2</sup> M. Hancher,<sup>2</sup> S. A. Tunbanova,<sup>1</sup> A. Tyukavina,<sup>1</sup> D. Thau,<sup>2</sup> S. V. Strhman,<sup>2</sup> S. J. Goetz,<sup>4</sup> T. R. Loveland,<sup>5</sup> A. Kommareddy,<sup>4</sup> A. Egorov,<sup>6</sup> L. Chie,<sup>1</sup> C. O. Justice,<sup>3</sup> J. R. G. Townshend<sup>1</sup>

Quantification of global forest change has been lacking despite the recognized importance of forest ecosystem services. In this study, Earth observation satellite data are used to map global forest loss (2.3 million km<sup>2</sup> in 2000) 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, 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.

**C**hanges 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 forest loss and gain, (iii) providing more detailed information on forest reg 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 categorized as the increase in loss, or the establishment of tree cover from a nonforest state. A total of 2.3 million km<sup>2</sup> of forest were lost due to disturbance over the study period and 0.8 million km<sup>2</sup> of new forest established. Of the total area of combined loss and gain (2.3 million km<sup>2</sup> + 0.8 million km<sup>2</sup>), 0.2 million km<sup>2</sup> of land experienced both losses 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, economies, and countries (refer to tables S1 to S3 for all data inflections and comparisons). Results are depicted in Fig. 1 and are viewable at [http://www.esri.com/arcswidgets/2013-global-forest-report/appet.com/science/2013-global-forest](http://www.esri.com/arcswidgets/2013/global-forest-report/appet.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

plete 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<sup>2</sup> of forest were lost due to disturbance over the study period and 0.8 million km<sup>2</sup> of new forest established. Of the total area of combined loss and gain (2.3 million km<sup>2</sup> + 0.8 million km<sup>2</sup>), 0.2 million km<sup>2</sup> 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, economies, 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/globaleforest>.

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 2180 km<sup>2</sup>/yr. Tropical rainforest economies 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

under the accession no. SRH402871. The genome assemblies are available at the National Center for Biotechnology Information under BioProject PRJNA77213. We thank Z. Walton and R. Gorchakov for technical assistance.

**Supplementary Materials**  
www.sciencemag.org/content/314/5808/666/suppl/DC1  
Materials and Methods

Supplementary Text  
Figs. S1 to S20  
Tables S1 to S3  
References (28-34)

23 April 2013; accepted 30 September 2013  
10.1136/bcr-2013-021994.2

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 (3) were confirmed, as annual forest loss decreased on average 1318 km<sup>2</sup>/year. However, increased annual loss of European tropical rainforest (11,000 km<sup>2</sup>/year), African tropical rainforest (1,636 km<sup>2</sup>/year), South American dry tropical forest (459 km<sup>2</sup>/year), and European tropical moist deciduous (221 km<sup>2</sup>/year) and dry (127 km<sup>2</sup>/year) forests more than offset the slowing of Brazilian deforestation. Of all countries globally, Brazil exhibited the largest decline in annual forest loss, from 1990 to 2003, with a 40% reduction in 2004 and a loss of under 20,000 km<sup>2</sup> in 2010 to 2011. Of all countries globally, Indonesia exhibited the largest increase in forest loss (1021 km<sup>2</sup>/year), with a loss of under 10,000 km<sup>2</sup> from 2000 through 2003 and a figure of over 10,000 km<sup>2</sup> in 2010 to 2011. The annual clearing rates of forest in 2010 to 2011 for the top clearing countries in the world (4) 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 (5). The effectiveness of Indonesia's recently instituted moratorium on new licensing of concessions in forest areas (6) is still uncertain (7). It is anticipated that, in 2011, it is to be determined.

Subtropical forests experience extensive land-use change where forests are often treated as a crop and the presence of biological natural forests is comparatively rare (3%). As a result, the highest proportional losses of forest cover and the lowest rates of loss to gain (3.2 for 350% of tree cover) occurred in the subtropical climate domain. Aggregate forest change, or the proportion of total forest loss and gain relative to zero (100% forest area [loss+gain]/2000 forest), equaled 10%, or more than 1% per year across all forests within the tropics and subtropics. Within the tropical dry forest ecosystem, 5 have aggregate forest change >20%, three >10%, and two <5%. North America has 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 ecosystem was four times that of South America

## REPORTS

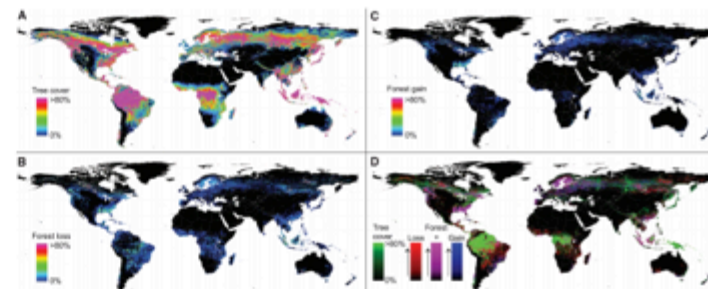


Fig. 1. (A) Tree cover, (B) forest loss, and (C) forest gain. A color composite of tree cover in green, forest loss in red, forest gain in blue, and forest loss and gain in magenta is shown in (D), with loss and gain enhanced for improved visualization. All map layers have been resampled for display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

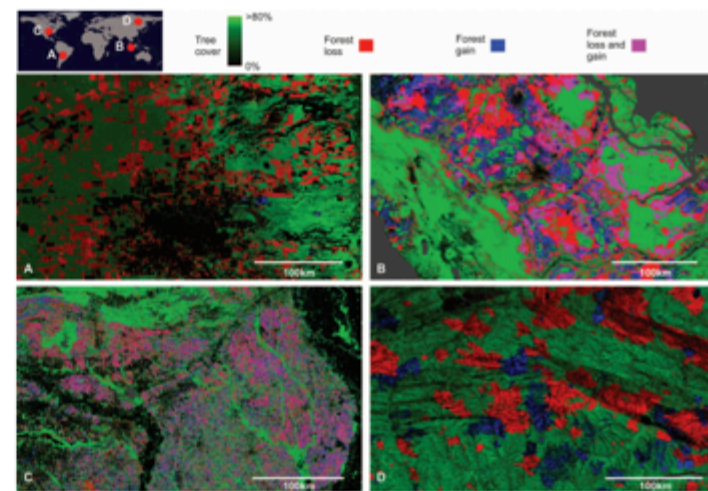
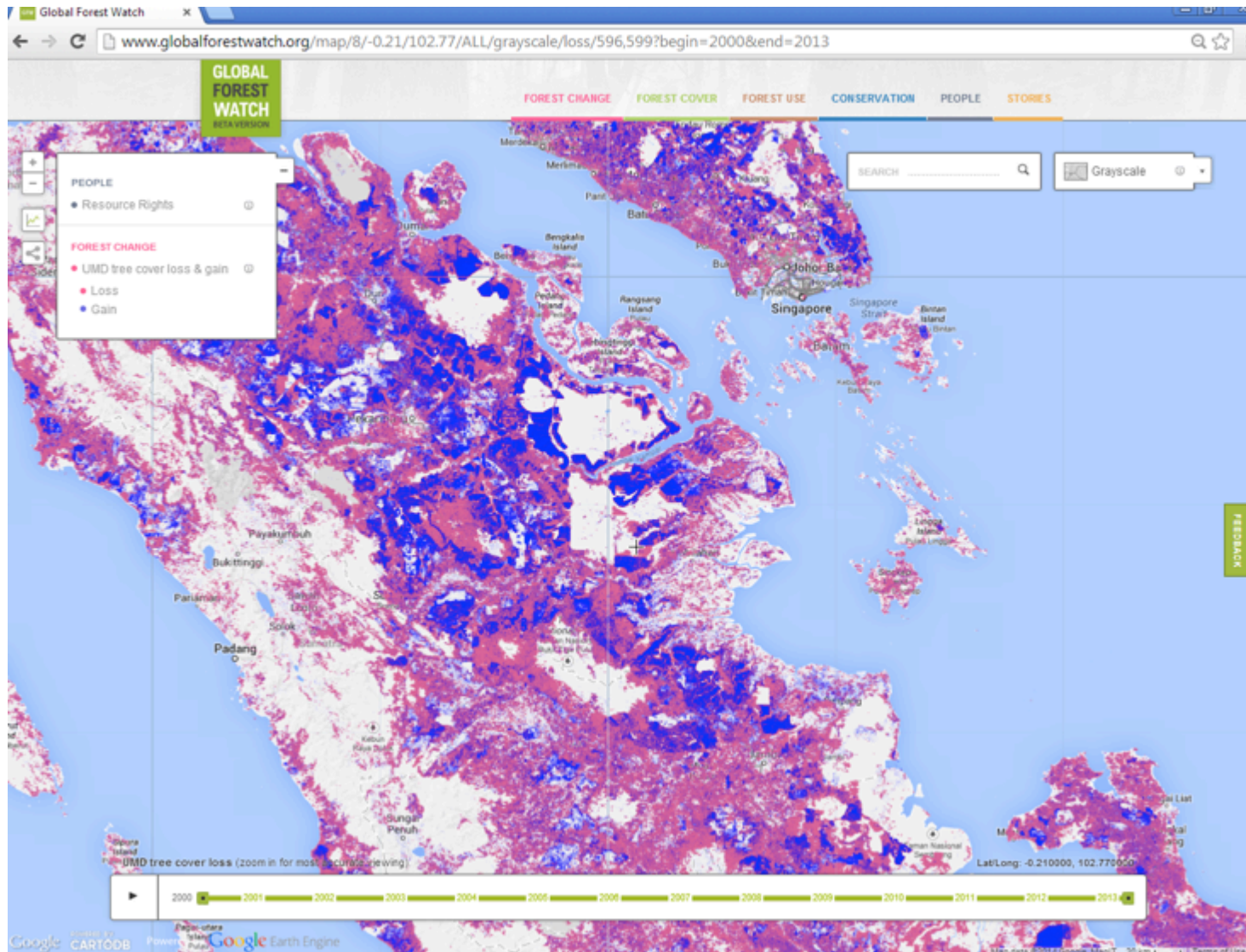
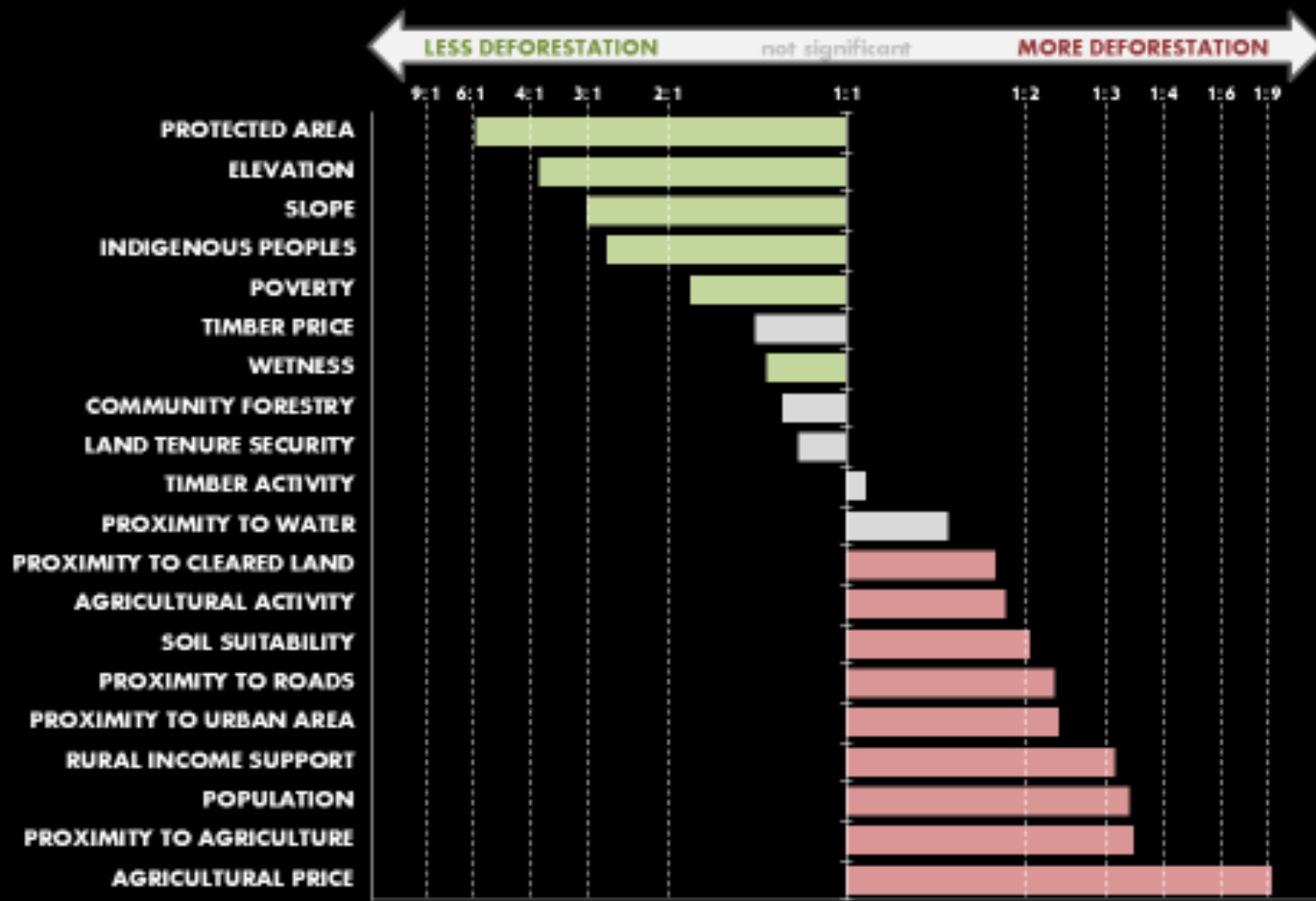


Fig. 2. Regional subsets of 2000 tree cover and 2000 to 2012 forest loss and gain. (A) Paraguay, centered at 21.9°S, 59.8°W; (B) Indonesia, centered at 0.4°S, 101.5°E; (C) the United States, centered at 33.8°N, 93.3°W; and (D) Russia, centered at 62.1°N, 123.4°E.

# ...or more accessible



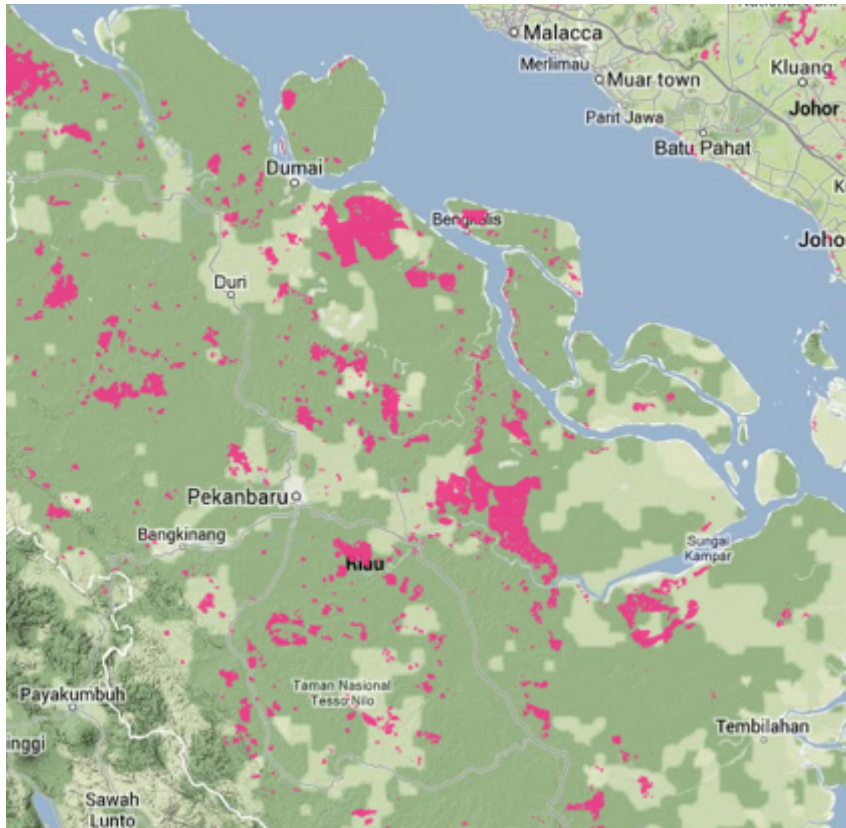
# We know what drives forest change...



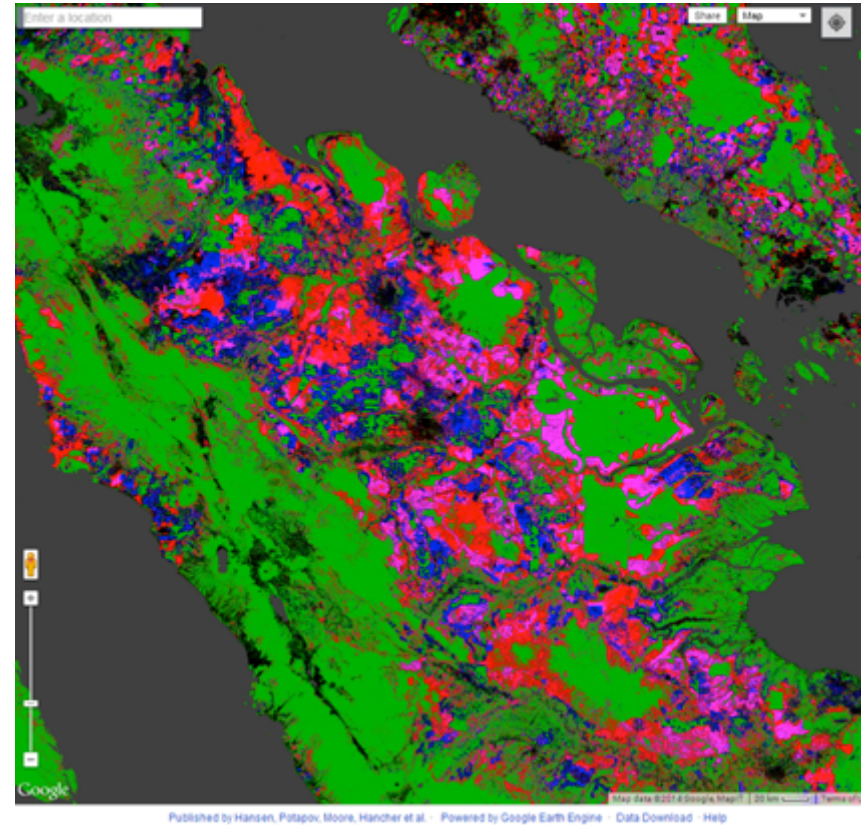
Ratio of regression coefficients showing significant negative association with deforestation to regression coefficients showing significant positive association with deforestation, based on 1663 regression coefficients in 117 spatially explicit econometric studies.  
Source: Ferretti-Gallon and Busch, CGD Working Paper #241 (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

**Thank you!**

