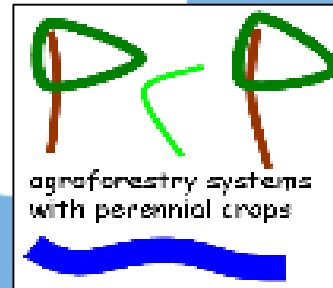


Landscape intensification and restoration in Central America: Impacts on soil C dynamics

Frederic Gay, Rolando Cerda, Miguel Cifuentes, Laurène Feintrenie,
Bryan Finegan, Grégoire Leclerc, Marie-Ange Ngo Bieng, Roberto Quiroz,
Eduardo Somarriba and Muhammad Ibrahim

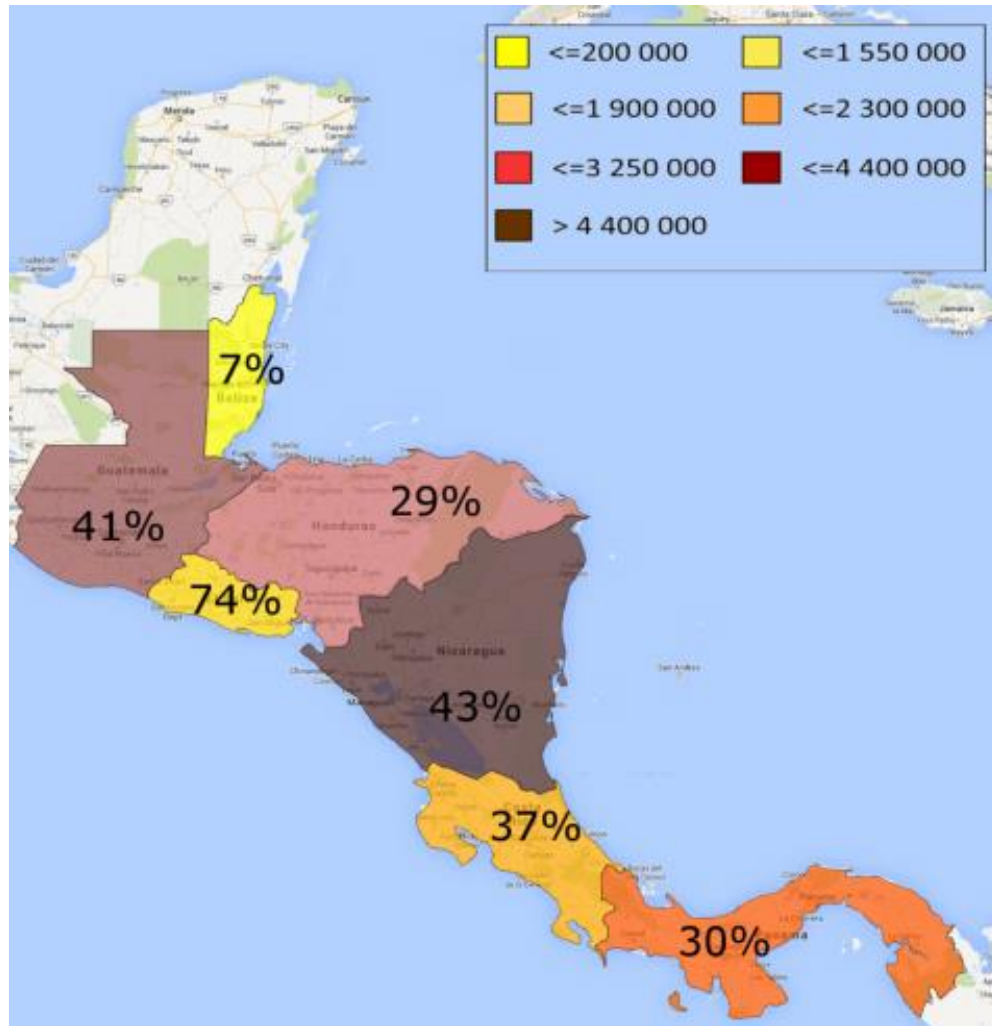
CIRAD – CATIE partnership

- More than **30 years** of collaboration
- **9 CIRAD's** researchers permanently posted at CATIE's headquarters in Turrialba

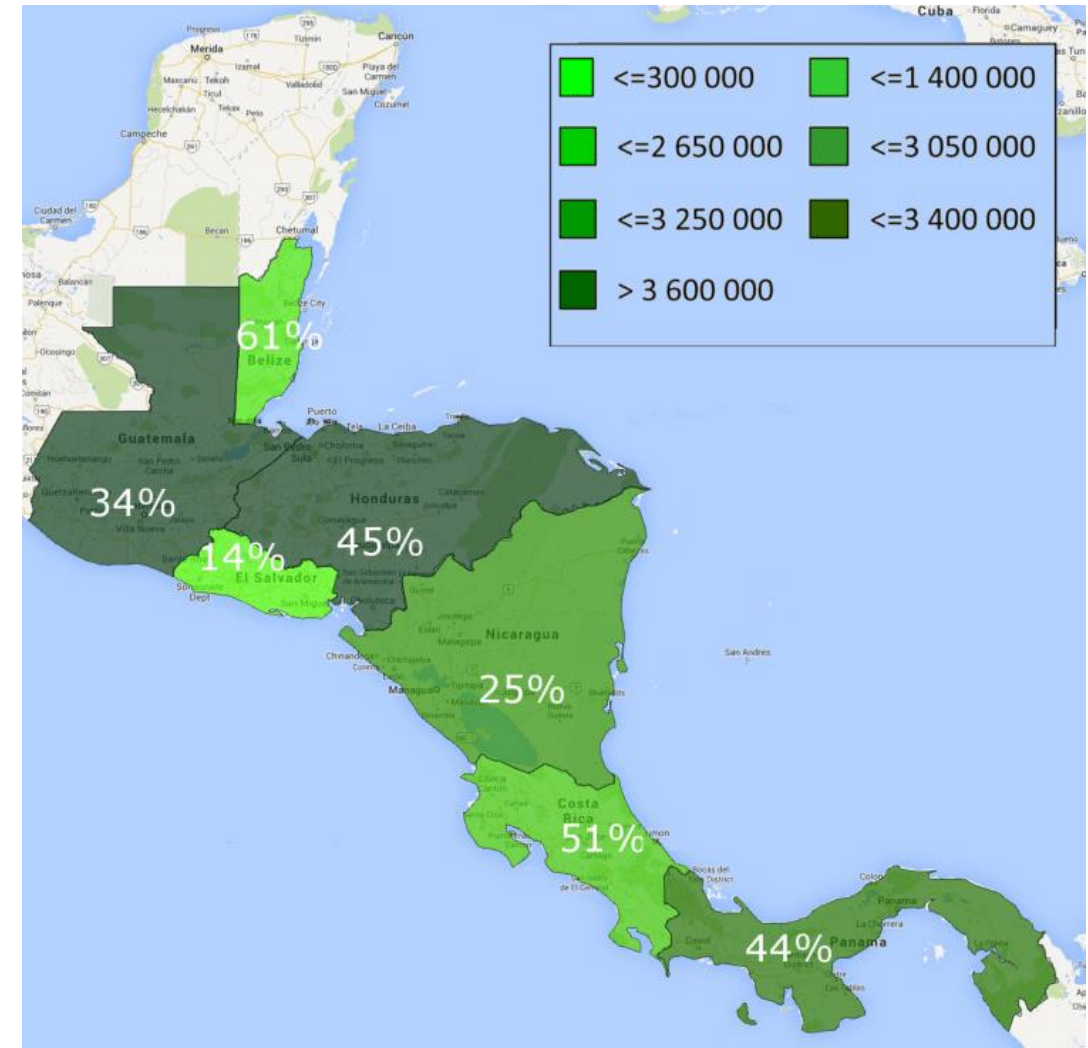


- A **collaborative platform** for research and capacity building on AgroForestry System (PCP AFS-PC)

Agricultural and Forest lands in Central America



Agricultural land (% total land)



Forest land (% total land)

Main agricultural land uses in CA



Permanent crops (mainly coffee/cocoa AFS)

10 to 20% of agricultural lands



Homegardens

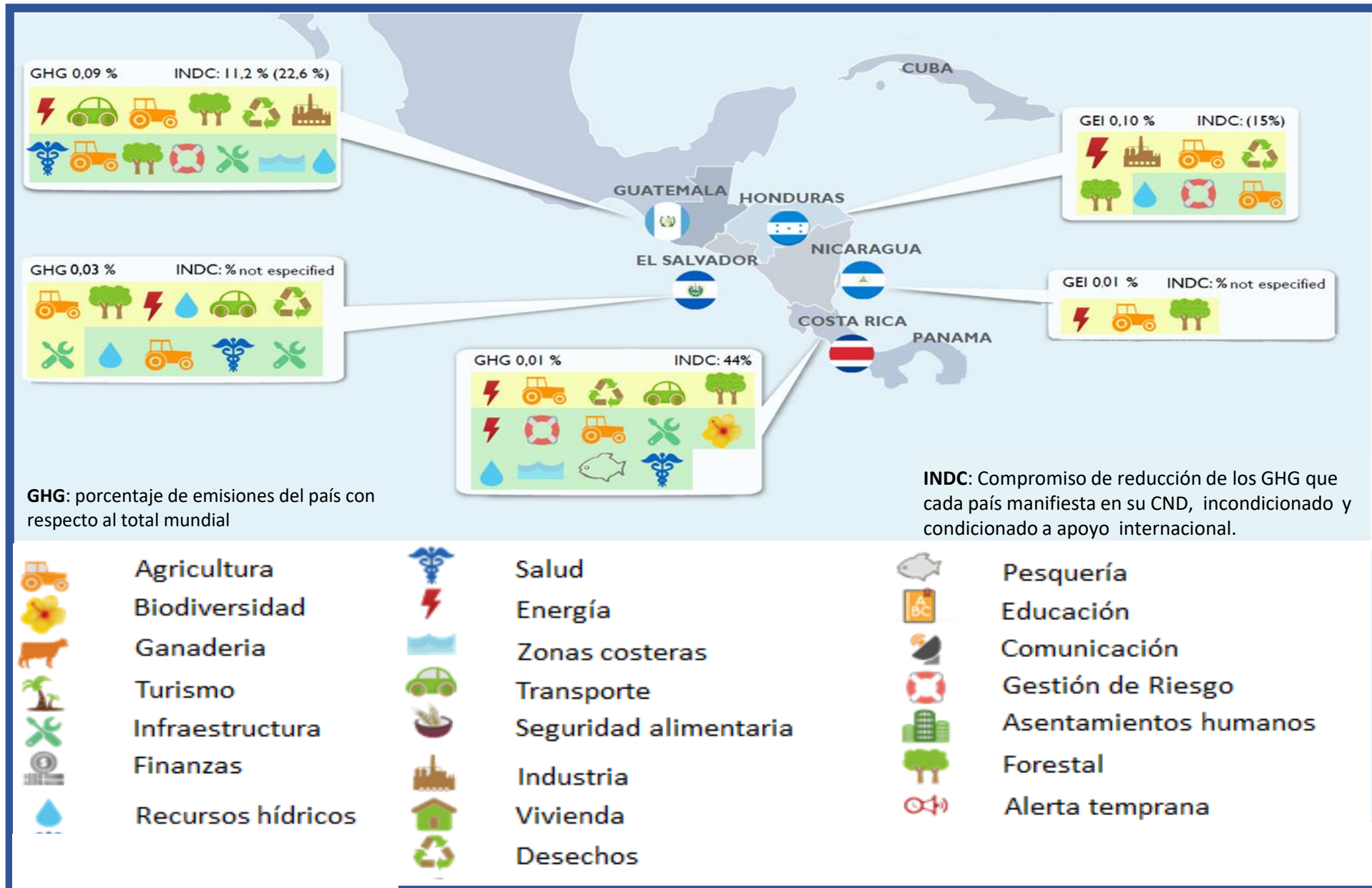


Pastures



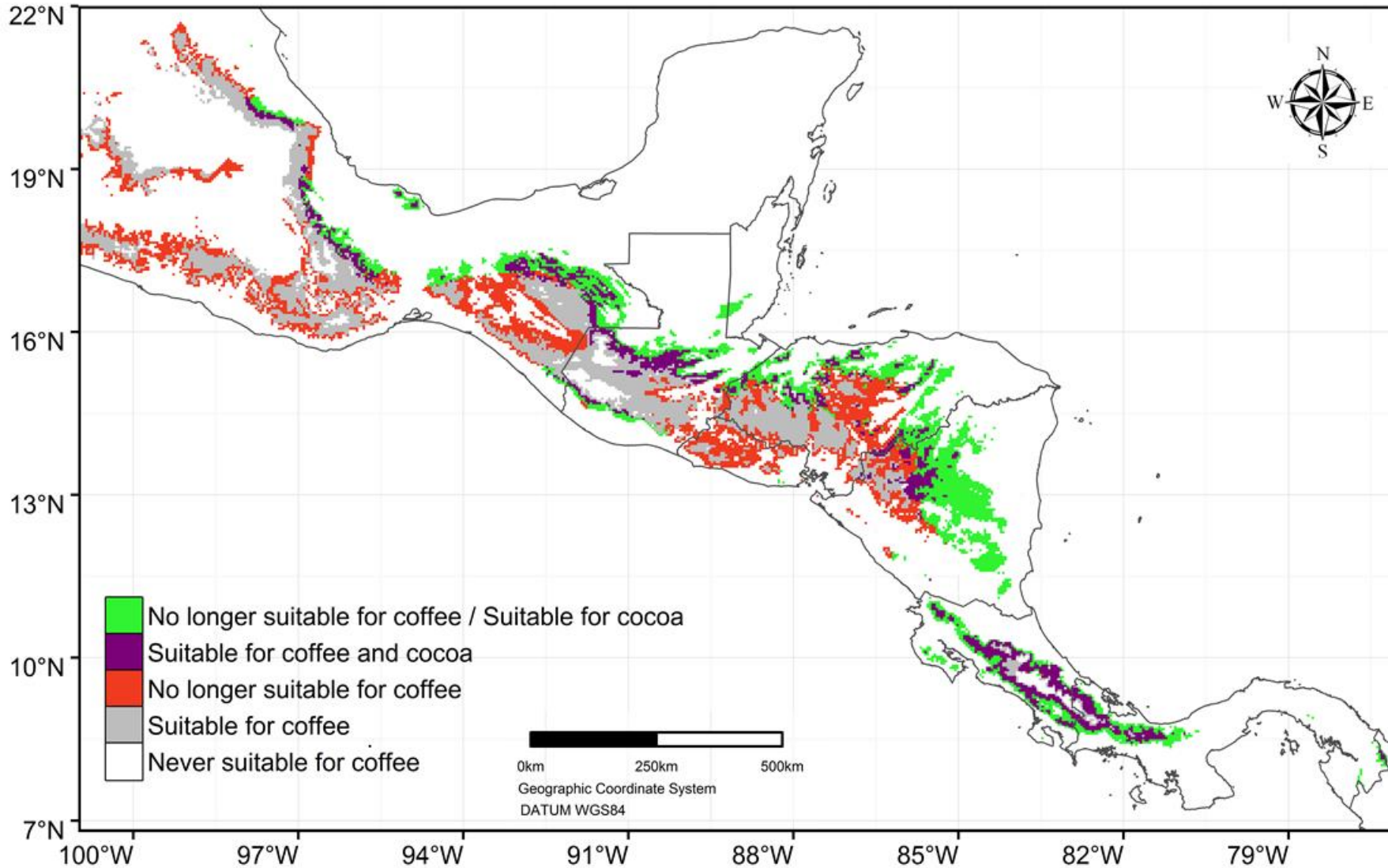
Annual and fruit crops

Central America and mitigation of CC....

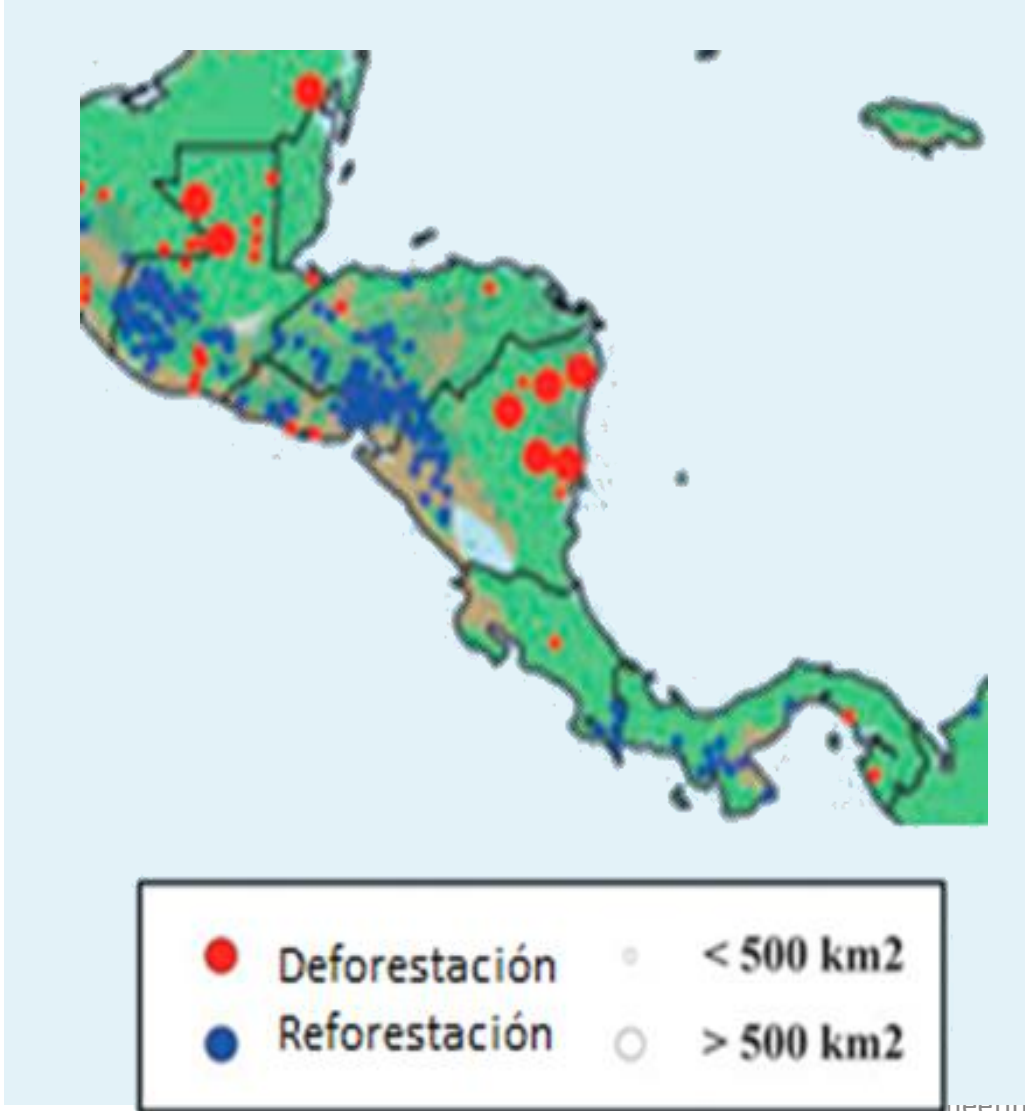


...necessary adptation to CC...

Cambios de idoneidad a 2050



And concerns about deforestation and land degradation



Nicaragua



Honduras,
Guatemala,
El Salvador

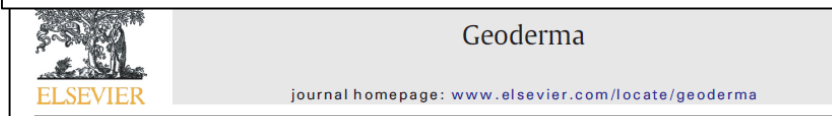
Extensive knoweldge on C dynamics in AFS and Forest lands in CA



Carbon stocks and cocoa yields in agroforestry systems of Central America

Eduardo Somarriba^{a,*}, Rolando Cerda^a, Luis Orozco^a, Miguel Cifuentes^a, Héctor Tania Espin^a, Henry Mavisoy^a, Guadalupe Ávila^a, Estefany Alvarado^a, Verónica Carlos Astorga^a, Eduardo Say^a, Olivier Deheuevls^{b,c}

^a CATIE, DID, 7170, Cartago, Turrialba 30501, Costa Rica
^b CIRAD, UMR System, F-34070 Montpellier, France
^c CATIE, PAAS, CR-7170 Turrialba, Costa Rica



Large topsoil organic carbon variability is controlled by Andisol properties and effectively assessed by VNIR spectroscopy in a coffee agroforestry system of Costa Rica

Rintaro Kinoshita^{a,*}, Olivier Roupsard^{b,c}, Tiphaine Chevallier^d, Alain Albrecht^d, Simon Tau Zia Ahmed^f, Harold M. van Es^a

^a School of Integrative Plant Science, Soil and Crop Sciences Section, Cornell University, Ithaca, NY 14853-1901, USA
^b CIRAD, UMR EcoSols (Ecologie Fonctionnelle & Biogéochimie des Sols et des Agro-écosystèmes), 34060 Montpellier, France
^c CATIE (Tropical Agricultural Centre for Research and Higher Education), 7170 Turrialba, Costa Rica



Indicating soil quality in cacao-based agroforestry systems: The potential of soil macrofauna assemblage

G.X. Rousseau^{a,*}, O. Deheuevls^{b,c}, I. Rodriguez Arias^d, E. Somarriba^e

^a Programa de Pós-Graduação em Agroecologia, Universidade Estadual do Maranhão, Caixa Postal 3004, 65000-000 São Luís, Maranhão, Brazil
^b CIRAD, UMR System, F-34070 Montpellier, France
^c CATIE, PAAS, CR-7170 Turrialba, Costa Rica



Changes in carbon stock and greenhouse gas balance in a coffee (*Coffea arabica*) monoculture versus an agroforestry system with *Inga densiflora*, in Costa Rica

Kristell Hergoualc'h^{a,b,c,*}, Eric Blanchart^d, Ute Skiba^e, Catherine Hénault^f, Jean-Michel Harmand^f

REGULAR ARTICLE

Growth, production and carbon sequestration of silvopastoral systems with native timber species in the dry lowlands of Costa Rica

Hernán J. Andrade · Robert Brook · Muhammad Ibrahim

Agroforest Syst (2009) 76:81–93
DOI 10.1007/s10457-008-9201-y

Soil characteristics below *Erythrina poeppigiana* in organic and conventional Costa Rican coffee plantations

Fidel Payán · Davey L. Jones · John Beer · Jean-Michel Harmand



Global controls on carbon storage in mangrove soils

André S. Rovai^{1,2,*}, Robert R. Twilley¹, Edward Castañeda-Moya^{1,8}, Pablo Riul³, Miguel Cifuentes-Jara⁴, Marilyn Manrow-Villalobos⁴, Paulo A. Horta^{2,5}, José C. Simonass⁶, Alessandra L. Fonseca⁷ and Paulo R. Pagliosa^{2,7}

Biogeochemistry (2008) 89:329–345
DOI 10.1007/s10533-008-9222-7

ORIGINAL PAPER

Fluxes of greenhouse gases from Andosols under coffee in monoculture or shaded by *Inga densiflora* in Costa Rica

Kristell Hergoualc'h · Ute Skiba · Jean-Michel Harmand · Catherine Hénault

Page 1 of 19
153, available online at www.aob.oxfordjournals.org



Carbon stocks, turnover and net primary productivity of a coffee agroforestry system in Costa Rica: effects of soil depth, shade trees, distance to row and coffee age

Kristell Hergoualc'h^{1,2}, Olivier Roupsard^{1,2}, Karel Van den Meersche^{1,2}, Fabien Charbonnier^{1,3,4}, Verónica Carlos Astorga⁵, or Pérez-Molina², Emmanuelle Khac¹, Iván Prieto⁵, Alexia Stokes⁶, Catherine Roumet⁵, Verónica Carlos Astorga^{2,7}, Elias de Melo Virginio Filho², Victor J. Vargas⁸, Diego Robelo⁵, Alejandra Barquero⁹ and Christophe Jourdan^{1,8}

¹ CIRAD, UMR System, F-34070 Montpellier, France, ² CATIE (Tropical Agricultural Centre for Research and Higher Education), 7170 Turrialba, Costa Rica, ³ CIRAD, UMR System, F-34070 Montpellier, France, ⁴ CIRAD, UMR System, F-34070 Montpellier, France, ⁵ CIRAD, UMR System, F-34070 Montpellier, France, ⁶ CIRAD, UMR System, F-34070 Montpellier, France, ⁷ CIRAD, UMR System, F-34070 Montpellier, France, ⁸ CIRAD, UMR System, F-34070 Montpellier, France, ⁹ CIRAD, UMR System, F-34070 Montpellier, France

Long-term experiment

Coffee Agroforestry Systems Experiment: More than a decade of pioneering results at a world level
Ensayo de Sistemas Agroforestales con Café: más de una década de resultados pioneros en el mundo

Turrialba - Costa Rica



Minimum period: 20 years
Began: August 2000

Participation:

MIP-Norway Program, CATIE, CIRAD, UCR, ICAFE

Producers Committee

A similar experiment is underway in the dry lowlands of Nicaragua with INTA, UNICAFE, UNA and CATIE.

Duración mínima: 20 años
Inició: agosto de 2000

Participación:

Programa MIP-Noruega, CATIE Sede, CIRAD, UCR, ICAFE

Comité de Productores

En zona baja seca de Nicaragua existe un experimento similar con INTA, UNICAFE, UNA y CATIE.



una producción económicamente viable

Science of the Total Environment 649 (2019) 1065–1074

Contents lists available at ScienceDirect



Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv



Shade trees have higher impact on soil nutrient availability and food web in organic than conventional coffee agroforestry

Marie Sauvadet^{a,b}, Karel Van den Meersche^{a,c,d}, Clémentine Allinne^{c,e,f}, Frédéric Gay^{a,c,d}, Elias de Melo Virginio Filho^c, Matthieu Chauvat^g, Thierry Becquer^a, Philippe Tixier^{h,i}, Jean-Michel Harmand^{a,j,k,*}



The "Coffee-Flux Collaborative Observatory": measuring and modeling carbon, nutrients, water and sediment Ecosystem Services in a coffee agroforestry watershed (Costa Rica).

CoffeeFlux Experimental display

Piezometers

Water table level

Roots, soil prop.

Soil

Rainfall

Vapor, Carbon, Climate

Flux Tower

Experimental Plots

S.Runoff + Erosion

LAI

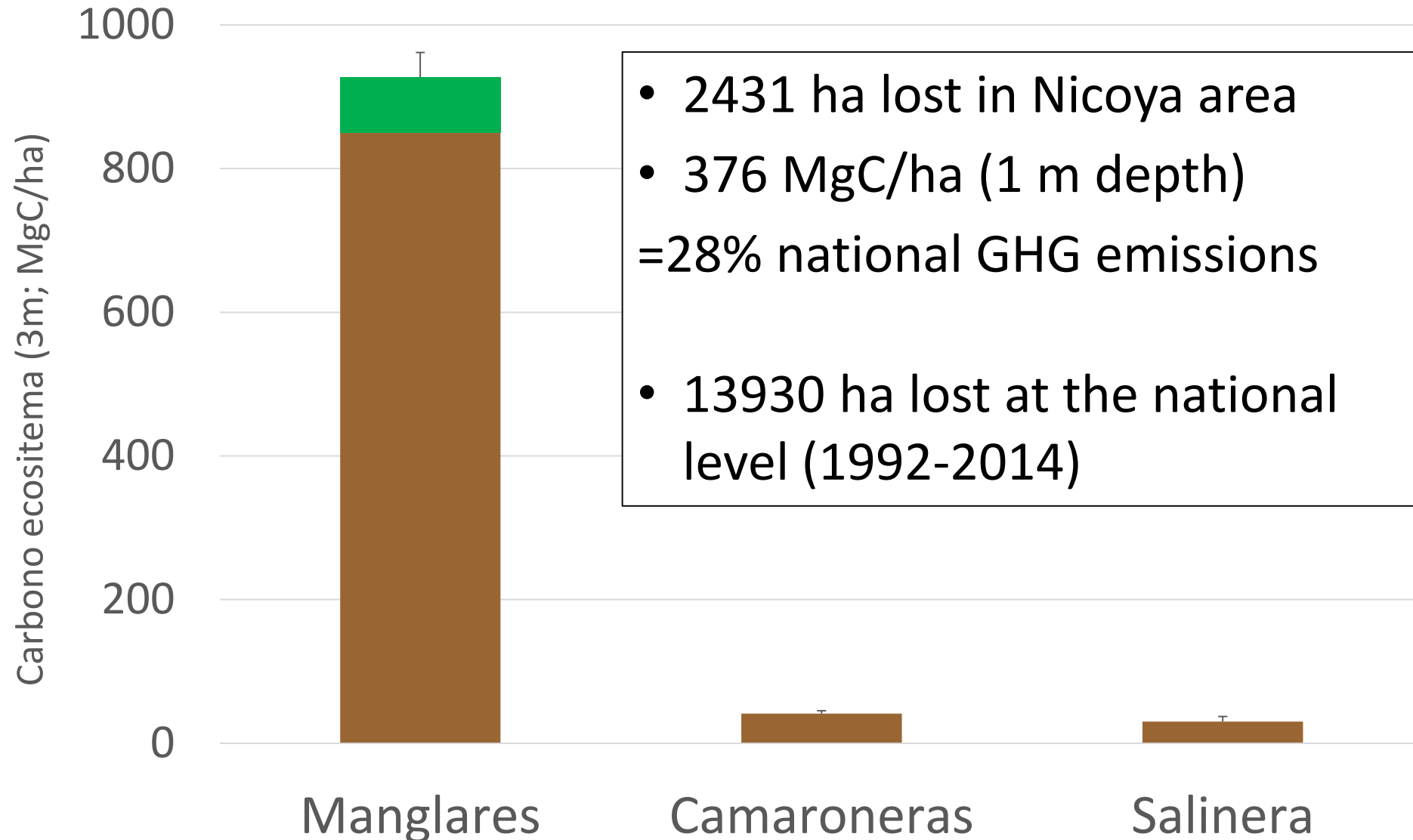
NAMA
Nationally Appropriate Mitigation Actions
CAFÉ DE COSTA RICA

AnaEE
Analysis and Experimentation on Ecosystems

FLUXNET
A Global Network

The central map shows a watershed with blue stream channels and red boundary lines. Yellow arrows point from various monitoring points on the map to corresponding images: piezometers for water table level, soil samples for soil properties, a flux tower for vapor, carbon, and climate, experimental plots for runoff and erosion, and a LAI sensor for leaf area index. A yellow circle highlights a specific monitoring point on the map.

Land use change: example of mangroves in Costa Rica



- 2431 ha lost in Nicoya area
- 376 MgC/ha (1 m depth)
=28% national GHG emissions
- 13930 ha lost at the national level (1992-2014)



What we plan to do

Databases of soil carbon content in Central America and Caribbean:

- Cocoa AF: > 200 plots in Panama, Costa Rica, Nicaragua, Honduras, Guatemala
- Coffee AF: 120 plots in Costa Rica
- Coffee AF: Aquiares farm and coffee agroforestry essays in Turrialba and Nicaragua
- >400 plots of different land uses in the sentinel landscape Nicaragua-Honduras: homegardens, pastures, annual crops, coffee and cocoa
- 140 plots in Dominican Republic: cocoa, coffee, pastures, avocado, coconut, mango
- SOC (0-30cm) degraded and secondary forests in Costa Rica



What we plan to do

Management of Landscape intensification: the Agriforlac proposal



Involucrar actores

Apoyo a la gobernanza y economía sostenible



Evaluar y optimizar los rendimientos de los usos del suelo

Agriforlac

Multifunctional agriculture, agroforestry and forestry for climate-smart landscapes in Latin America and the Caribbean



Diseñar paisajes sostenibles y climáticamente inteligentes



What we plan to do

Landscape restoration

Initiative 20x20

Bringing 20 million hectares of degraded land in Latin America and the Caribbean into restoration by 2020.

Climate-smart, socially inclusive forest landscape restoration in tropical America

Work package 3: Restoring forest ecosystems and ecosystem services: spatial prioritization, planning and implementation: (CATIE, CIRAD).

Layers Basemap

Bonn Challenge

Restoration Opportunities

Forest Condition

transparency

Condition of
and Woodlands

ct

gumented/managed

graded

restored

st Coverage

Potential Forest Coverage

Human Pressure

Bonn Challenge

Restoration Opportunities

transparency

Restoration Opportunity Areas

- Wide-scale restoration
- Mosaic restoration
- Remote restoration

Other Areas

- Urban areas
- Forest

Forest Condition

Current Forest Coverage

Potential Forest Coverage



<http://www.wri.org/applications/maps/flr-atlas/#>



GRACIAS



agroforestry systems
with perennial crops



Frederic.gay@cirad.fr