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"Resilience of agricultural systems against crises"

The Need for Eco-Efficient Landscapes to Prevent Irreversible Degradation of Agroecosystems in Deforested Amazonia

Patrick Lavelle[1,9], Sylvain Doledec[2], Valery Gond[3], Johan Oszwald[4], Iran Veiga[5], Bertha Ramirez[6], W. Santos[5], X. Arnauld de Sartre[7], Thibaud Decaens[8], Michel Grimaldi[9], B. Hubert[10], M. Martins[11], P. Lena[9], P. de Robert[9], A. Feijoo[12], M.P. Hurtado[9], G. Rodriguez[6], D. Mitja[9], I. Miranda[13], E. Gordillo[6], E. Velasquez[14], T. Otero[14], A. Velasquez[6], J.M. Thiollay[9], S. de Sousa[5], L.E. Moreno[6], George Brown[15], R. Marichal[16,9], P. Chacon[17], C. Sanabria[17], T. Desjardins[9], T. Santana Lima[13], F. Michelotti[5], O. Villanueva[6], Jaime Velasquez[6], E. Guevarra[1], Steve Fonte[1]

[1] *International Center for Agricultural Resarch (CIAT), TSBF Institute, Colombia*
[2] *Lyon 1 University, France*
[3] *CIRAD, France*
[4] *Rennes 2 University, Geography, France*
[5] *Federal University of Para, NEAF, Brazil*
[6] *Universidad de la Amazonia, Florencia, Colombia*
[7] *Pau University, Geography, France*
[8] *Rouen University, Ecology, France*
[9] *Institut de Recherche pour le Développement (IRD), France*
[10] *Institut National de la Recherche Agronomique, France*
[11] *Museu Paraense Emílio Goeldi, Brazil*
[12] *Universidad Tecnológiga de Pereira, Faculdad de Ciencias Ambientales, Colombia*
[13] *Universidade Federal Rural da Amazônia, Brazil*
[14] *Universidad Nacional de Colombia, Colombia*
[15] *EMBRAPA Forestry, CNPF, Brazil*
[16] *Université Pierre et Marie Curie, France*
[17] *Universidad del Valle, Colombia*

Abstract

Considerable effort has been devoted to the conservation of primary forest in the Amazon, but less so to design and implement ecoefficient uses of cleared land for meeting the economic, social and environmental challenges faced in the region. We conducted a multidisciplinary diagnostic of ecoefficiency in 51 farms from six regions of the Brazilian and Colombian Amazon cleared between 15 to 60 years ago, with diverse colonisation histories. Land-use intensity was assessed with an indicator based on present landscape composition and structure and the historical land-use change. Indicators of soil ecosystem services (ES: chemical fertility, hydric functions and C storage) and biodiversity of plants and 5 soil and above ground invertebrate groups were assessed. Intensity of land-use increased with time elapsed since deforestation along with production efficiency (farm incomes per ha and per labour unit) and social wellbeing. Meanwhile, an indicator of biodiversity continued unchanged as land-use intensity increased until a well-marked tipping point, beyond which

Contact Address: Patrick Lavelle, International Center for Agricultural Resarch (CIAT), TSBF Institute, Cali, Colombia, e-mail: p.lavelle@cgiar.org

biodiversity fell sharply. A composite indicator of soil ES decreased regularly with land-use intensity. An ecoefficiency index, that combines indicators of social wellbeing, productivity, biodiversity and ES, also exhibited a sudden decrease when land-use intensity exceeded a critical threshold value. This tipping point corresponds with a shift from predominantly forested to open agropastoral landscapes, when the last forest patches become fragmented before disappearing. At that point, only 20 % of the original primary forest is left on average. Landscapes dominated by agroforestry production systems had much higher ecoefficiency, with a higher productivity than extensive livestock breeding systems and greater conservation of biodiversity and ES. Our study indicates the need for reconstructing landscapes in deforested Amazonia, by identifying the best spatial combination of productive systems that sustain livelihoods and natural ecosystems that act as buffers to prevent degradation of ES and biodiversity.

Keywords: Amazonia, biodiversity, ecoefficiency, ecosystem services, land use intensity, landscape, tipping point