



Soil and vegetation carbon stocks after land-use changes in a seasonally dry tropical forest

Rômulo Simões Cezar Menezes^{a,*}, Aldo Torres Sales^a, Dário Costa Primo^a,
Eliza Rosário Gomes Marinho de Albuquerque^b, Kennedy Nascimento de Jesus^c,
Frans Germain Corneel Pareyn^b, Mônica da Silva Santana^d, Uemeson José dos Santos^a,
Júlio César Rodrigues Martins^c, Tiago Diniz Althoff^a, Diego Marcelino do Nascimento^a,
Rafael Feitosa Gouveia^e, Milton Marques Fernandes^f, Diego Campana Loureiro^g,
José Coelho de Araújo Filho^h, Vanderlise Giongoⁱ, Gustavo Pereira Duda^j,
Bruno José Rodrigues Alves^k, Walane Maria Pereira de Mello Ivo^l, Eunice Maia de Andrade^m,
Alexandre de Siqueira Pinto^e, Everardo Valadares de Sá Barretto Sampaio^a

^a Department of Nuclear Energy, Federal University of Pernambuco, Av. Prof. Luís Freire, 1000, Recife, PE, Brazil

^b Associação Plantas do Nordeste – APNE, Rua Dr. Nina Rodrigues, Recife, PE, Brazil

^c Faculdades de Enfermagem Nova Esperança, Av. Frei Galvão, 12, João Pessoa, PB, Brazil

^d Ecology and Natural Resources, Department of Biology, Federal University of Ceará, Fortaleza, CE, Brazil

^e Department of Ecology, Federal University of Sergipe, Av. Marechal Rondon, s/n, São Cristóvão, SE, Brazil

^f Department of Forest Science, Federal University of Sergipe, Av. Marechal Rondon, s/n, São Cristóvão, SE, Brazil

^g Department of Agricultural Engineering, Federal University of Sergipe, Av. Marechal Rondon, s/n, São Cristóvão, SE, Brazil

^h Empresa Brasileira de Pesquisa Agropecuária, Rua Antônio Falcão, 402, Recife, PE, Brazil

ⁱ Empresa Brasileira de Pesquisa Agropecuária, Rodovia BR 428, Km 152, Zona Rural, Petrolina, PE, Brazil

^j Federal University of the Agreste of Pernambuco, Av. Bom Pastor, s/n, Garanhuns, PE, Brazil

^k Empresa Brasileira de Pesquisa Agropecuária, Rodovia BR-465, Agroecologia, Seropédica, RJ, Brazil

^l Empresa Brasileira de Pesquisa Agropecuária, BR 104 Norte - Km 85, Campus Delza Gitaí, Rio Largo, AL, Brazil

^m Department of Soil and Water Conservation, Federal University of the Federal University of the Semi-Arid Region, Rua Francisco Mota Bairro, 572, RN, Brazil

ARTICLE INFO

Handling Editor: Cornelia Rumpel

Keywords:

Caatinga
Deforestation
Ecosystem C stocks
Arid regions
NE Brazil

ABSTRACT

The lack of robust scientific data still hinders estimates of soil and plant carbon (C) losses due to land-use changes in most dry tropical ecosystems. The present study investigated the effects of land-use and cover changes on total ecosystem C stocks in NE Brazil, aiming to quantify C losses after the removal of the native forest, known as Caatinga. The sampling design included the four main land-use/cover types (Dense Caatinga, Open Caatinga, Pastures and Crop fields) and the seven main soil classes (Arenosols, Acrisols, Regosols, Ferrasols, Luvisols, Planosols, and Leptosols), a combination that represents over 90% of the region. This design resulted in 192 sampling points (48 in each land-use), distributed proportionally to the area of occurrence of each soil class. In each sampling point, we determined C stocks in soil organic matter (SOM) and roots (to a depth of 1 m or rock layer), aboveground vegetation biomass (trees and herbs, separately), deadwood, and surface litter. Areas covered by Dense Caatinga store, on average, nearly 125 Mg ha⁻¹ of C. Most of this C is stored in the soil organic matter (72.1%), followed by aboveground biomass (15.9%), belowground biomass (7.3%), deadwood (2.9%), litter (1.3%), and herbaceous biomass (0.5%). The substitution of Dense Caatinga to plant pastures and crop fields caused losses of >50% of ecosystem C stocks, reaching almost 65 Mg ha⁻¹ of C, with nearly equal losses from the SOM and vegetation biomass compartments. Open Caatinga store nearly 30% less C than Dense Caatinga. Contrary to what was expected, the overall differences in C stocks between soil classes were not significant, with a few exceptions. We expect that the findings of this study will contribute to a more robust inventory of GHG emissions/removals due to land-use changes in NE Brazil and other dry tropical regions of the globe.

* Corresponding author.

E-mail address: romulo.menezes@ufpe.br (R.S.C. Menezes).

<https://doi.org/10.1016/j.geoderma.2021.114943>

Received 13 July 2020; Received in revised form 6 November 2020; Accepted 8 January 2021

Available online 7 February 2021

0016-7061/© 2021 Elsevier B.V. All rights reserved.