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**Ecological comparison of carbon neutral certified
and non-certified coffee farms
in the Los Santos Valley, Costa Rica**

Master's Thesis

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Abstract

Climate change is significantly driven by human activities, including agriculture, which is a major source of greenhouse gas (GHG) emissions and is also vulnerable to climate change. Costa Rica, a major exporter of coffee and other agricultural commodities, aims to achieve carbon neutrality by 2021. Coffee is not only a big driver of GHG emissions, but also has the potential to sequester carbon and mitigate climate change. This study investigated the ecological differences between carbon neutral certified and non-certified coffee farms in the mountainous Los Santos region of Costa Rica at an altitude of around 1700 m a.s.l.. Transects (10 m x 20 m) were selected within the eight investigated farms. Within these transects, temperature and humidity were measured for four days with Tinytag plus two sensors. Transmission of photosynthetic active radiation (PAR) and leaf area index (LAI) measurements were done in the course of a day with AccuPAR LP80 and LAI2000, respectively. For eight coffee plants per transect, five leaves, each from the upper and lower part, were harvested and analysed for length (L), width (W), leaf area (LA), fresh weight (FW), dry weight (DW), specific leaf area (SLA), nitrogen (N) and carbon (C) concentration and C/N ratio. The biomass and carbon concentration of shade plants (trees and *Musa sp.*), coffee plants and of the roots were estimated using allometric equations and the species richness of the understory crops (bushes and weeds) was determined. No significant differences between the ecological parameters of carbon neutral certified and non-certified coffee farms of this region were found. The cooperative Coopedota R. L. gives similar recommendations to all their farmers. Field carbon sequestration is not considered in the certification and not all farmers, who carry out management practices worthy of the certification, are certified. This explains the ecological similarity of all farms studied. Some temperature extremes were observed on farms and the PAR transmission of the trees varied between 45 and 95%. The carbon stock (above ground and roots) of the monitored transects varied between 25 and 70 Mg ha⁻¹. Therefore, some farms still have the potential to include more trees or *Musa sp.* in the field to sequester more carbon.

Keywords: *Carbon neutral, Coffea arabica, climate change, carbon stock, LAI, PAR*