Comparison of the amount of carbon sequestered in different land use in the Amazon highland

Karolína Chalupová[1], Jesus Hernández Castán[2], Jorge Mattos Olavarría[2], Lenka Ehrenbergerová[1]

[1] Mendel University in Brno
[2] GITEC

Introduction

The Andean tropical montane forest includes many types of ecosystems, which, to some extent, are capable of carbon sequestration. If we want to understand carbon management in the mountainous region of the Amazon, we need to know how the most representative ecosystems here behave. Therefore, we decided to study the tropical montane forests of the Andean region, pastures, and agroforestry coffee plantations at an altitude of 1760–2470 meters above sea level.

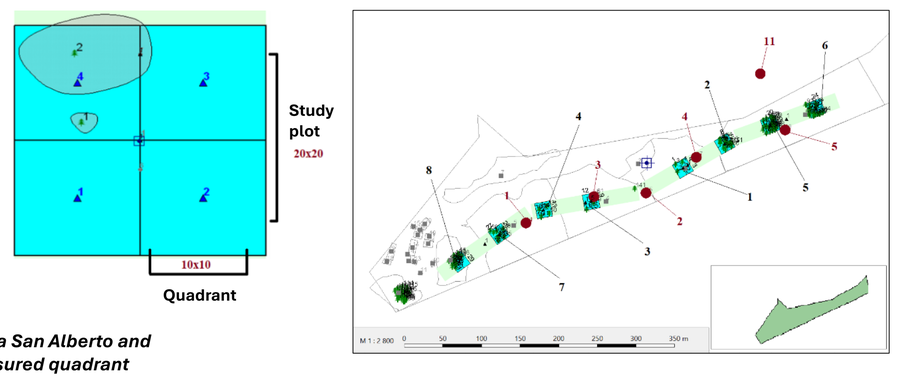
The findings can help not only to understand the global carbon cycle, setting up trade with it, but also local governments dynamics in deciding on the most appropriate strategy for setting carbon emission reductions.

The studied secondary grown sparce forest is located on a land that was previously utilized for agricultural purposes. It is characterized by the presence of low-stature trees, with average density of 220 ± 76 trees/ha^{-1}. The dominant species are: *Cedrelinga cateniformis*, *Pouteria torta*, *Simarouba amara*, *Dilotropi purpurea* or *Cedrela odorata*. From coffee agroforestry systems, three smallholders with *Coffea arabica* and different shading trees (*Pinus tecunumannii*, *P. oocarpa*, *P. patula*, and *Inga* spp.), with average density of 251 ± 157 trees/ha^{-1}, were selected. These agroforestry plantations were compared to above mentioned forest stands and pastures, which were composed mainly of *Setaria* spp. and *Cynodon nlemfuensis*.

Material and methods

The study was carried out around the Oxapampa city, the Pasco region; located at 10.574° S, 75.405° W in the vicinity of the National Park Yanachaga Chemillen. In total, 77 study plots (400 m^2) were measured across 8 transects.

All completed transects had a width of 20 meters, extending to a total length of 560 meters, traced in a straight line northward. Tree location, total height, and diameter at breast height (DBH ≥ 5 cm; measured at 1,3 m) were recorded. To estimate aboveground biomass and carbon, allometric equations by Chave et al. (2014) and Segura et al. (2006) were used. Root biomass was estimated with an equation by Cairns et al. (1997). The evaluation of soil carbon stocks (within the depth of 30 cm) was determined based on soil analysis using a Soli-TOC device (Elementar, Langenselbold Germany), where carbon (TOC) was determined by thermal differentiation (DIN19539 method).



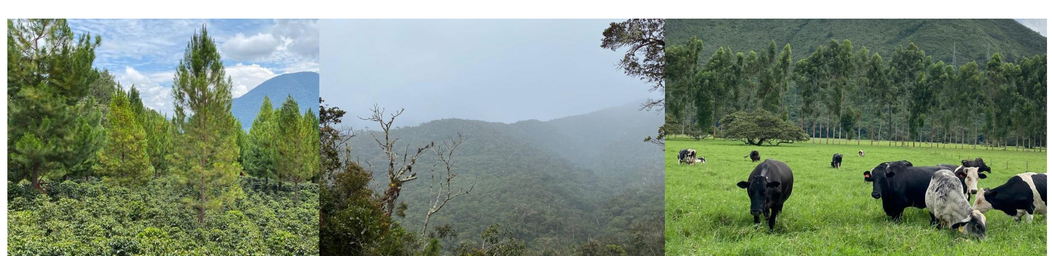
Transect 1, Finca San Alberto and scheme of measured quadrant

Results

The results varied according to different types of land use. The highest carbon content was found in the coffee agroforestry plantations (the biomass of coffee shrubs was not included), followed by pastures and then by secondary forest stands. According to Chave et al. (2014), the total carbon amount in coffee agroforestry systems was 19,7 ± 21,3 Mg/ha, whereas Segura et al. (2006) estimated it to be 14,7 ±12,7 Mg/ha. For tropical montane forests, it was 7,9 ± 4,8 Mg/ha (Chave et al., 2014) and 6,9 ± 3,7 Mg/ha (Segura et al., 2006). In pastures, the total carbon amount was estimated on 12,71 Mg/ha.

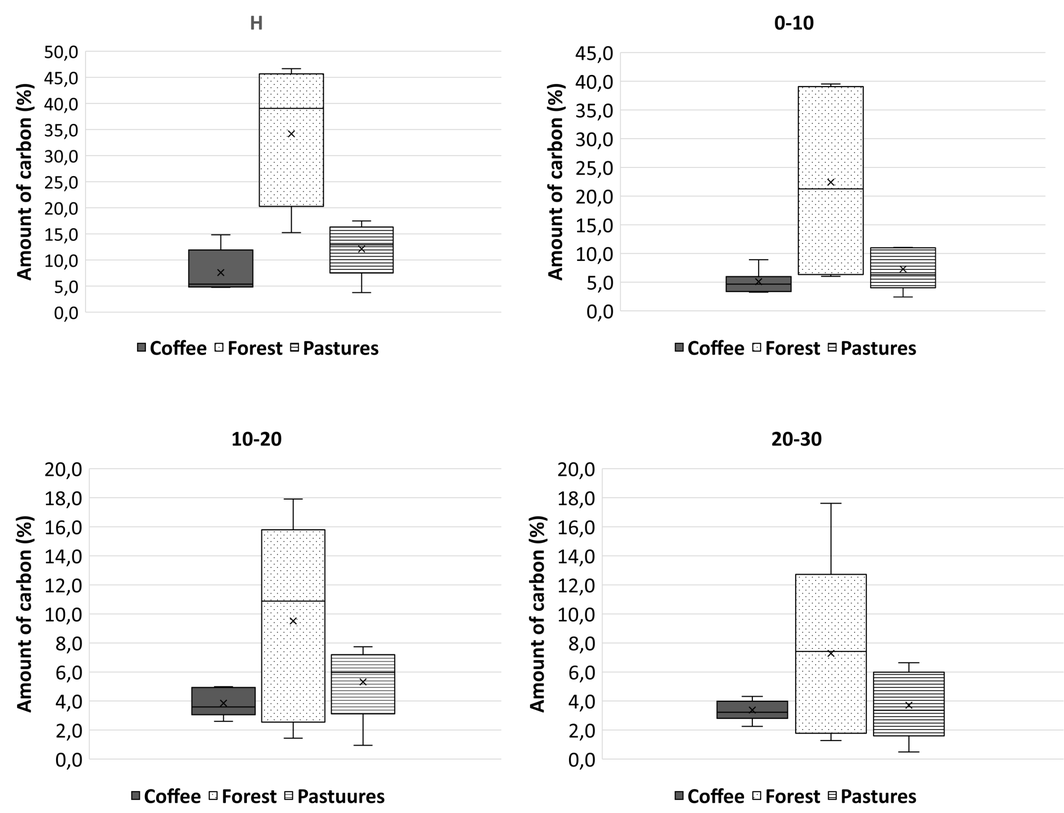
The variation in results from allometric equations among the studied land uses was attributed to the higher tree density in the measured coffee plantation plots compared to forest stands. Individuals in agroforestry plots often grew to larger sizes. Furthermore, It is important to emphasize that coffee plantations and pastures have been compared to relatively young and disturbed secondary forests, which explains why they show such low values of sequestered carbon.

	Equation	Explanations	Author
1	$AGB = 0,0673\ x\ (\rho D^2 H)^{0,976}$	AGB – above-ground biomass (kg); D – diameter at breast height (cm); ρ – specific density (g.cm-3); H – total height of the tree (m).	Chave et al. 2014
2	$Log_{10} Y = a + b \times Log_{10} dbh$	Y – bellow-ground biomass (kg) a – specified coefficient (-0,834); b – specified coefficient (2,223); DBH – diameter at breast height.	Segura et al. 2006
3	$Y(RBD) = [\exp(-1,0850 + 0,9256\ (lnA)]$	Y (RBD) – root biomass (Mg/ha) A – density of above-ground biomass	Cairns et al. 1997



Soil carbon stock

Soil carbon stocks were highest in forest stands in the upper soil layers. At lower depths (20–30 cm) the difference between the studied ecosystems was no longer registered.



Acknowledgements

The project was supported by the Specific University Research Fund MENDELU.

Contact
Karolína Chalupová
xchalup4@mendelu.cz
+420 545 134 064
Mendel University in Brno