



ECOSYSTEM SERVICE FOR SEQUESTRATION AND MAINTENANCE OF CARBON STOCK IN A FOREST UNDER SUSTAINABLE FOREST MANAGEMENT IN THE AMAZON



AUTHOR

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The sustainable management of forests is essential to maintain them as a carbon sink rather than a carbon-generating source. Consequently, this is one of the best options for the remaining areas of the Amazon Forest (SANTOS, 1996). Sustainable Forest Management (SFM) can be seen as one of the means for mitigation of problems caused due to the high rates of carbon emission into the atmosphere. It presents two alternatives; the first is for the managed forest to store carbon during regeneration, and the second is to reduce carbon emissions since conventional harvesting causes a more significant impact than SFM (SILVA, 2015). The data from this study were used for FSC Ecosystem Services Procedures for Carbon Sequestration and Storage at Precious Woods – MIL Madeiras Preciosas.



Scope and objectives

- The objective of this study was to analyze the balance of aboveground carbon stocks in a forest under SFM in the Brazilian Amazon. It was conducted with data from 41 permanent plots inside the SFM area of Precious Woods in Brazil, State of Amazon (Figure 1). At the same time, satellite image observation was used to study the preservation of forest cover in the total managed and unmanaged area.
- Carbon stock estimated in the above ground biomass. The carbon stock above ground was estimated based on the results of Vasconcelos (2016) study, by continuous inventory with 41 Permanent plots of 1 hectare each, distributed in the forest management area of Precious Woods. All trees (DBH ≥ 15 cm) are identified by continuous numbering, and changes in each tree's environmental and physiological aspects can be monitored over the years. Measurements are preferably carried out one year before harvesting and remeasurements in subsequent years after harvest.
- In this study the following equation was used :
$$AGBest = (1.803 - 0.976 E + 0.976 \ln(p) + 2.673 \ln(D) - 0.0299 (\ln(D)^2))$$

Where: AGBest = Aboveground biomass; P = Basic density (g/cm^3); Ln = Logarithm on the natural base (neperian logarithm); d = DBH (cm); E=(0.178 TS - 0.938 CWD - 6.61 PS)10⁻³; TS = Average temperature of the period; CWD = Climatological Water Deficit; PS = Average precipitation of the period.
The average carbon stock (biomass above ground level) was estimated at 165.7 (±24.1) t.ha⁻¹
- Biomass estimated in the non managed area. Annual analysis with 1st August as the reference date was performed to estimate forest change in the 12 months period. The increase in deforestation is done through photo interpretation by specialists, where an exclusion mask is used. It covers the areas deforested in previous years, making it impossible for old deforestation to be mapped again.

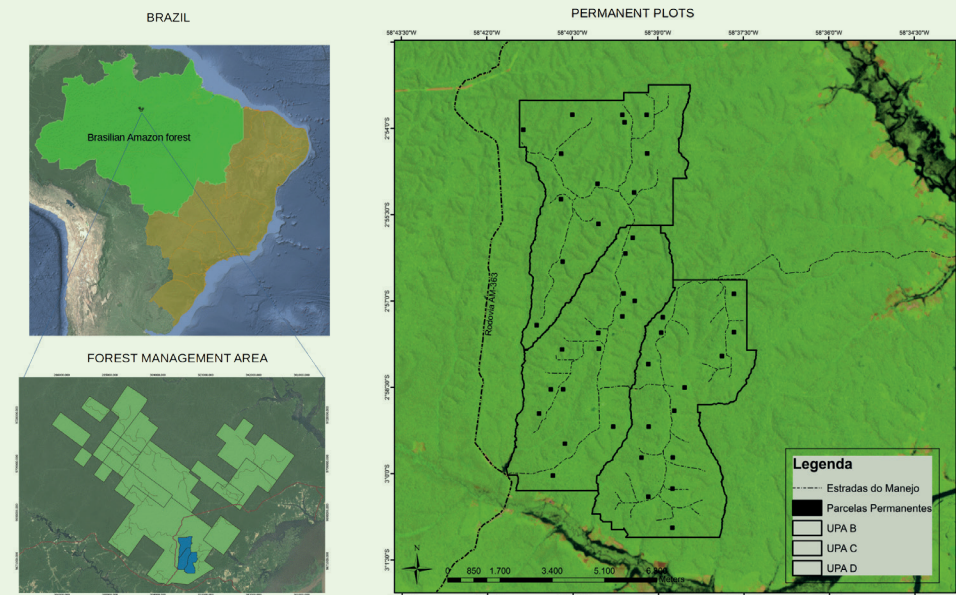


Figure 1

Figure 1: (A) Geographic location of the Forest Management Area of Precious Woods - Mil Madeiras Preciosas in the municipalities of Itacaitana, Silveira, and Itapiranga, State of Amazonas. (B) Location of 41 permanent plots in APU (annual production unit) B, C, and D.



Findings

- Based on the results of carbon stock surveys, as well as remote sensing information, the total carbon stock of aboveground biomass in the entire forest area (Figure 2) was calculated for the year 2008 at 79,864,225.27 tons (168.56 t.ha⁻¹ ± 14.4) and or the year 2020 at 76,508,299.03 tons (161.47 t.ha⁻¹ ± 14.4).
- Bearing in mind the effects of forest management activities on the ecosystem service, Figure 3 presents an analysis of the variation of aboveground carbon stock in the forest management area before and after forest harvesting. With this analysis, the relative preservation of the carbon stock over the years can be observed (Figure 3).

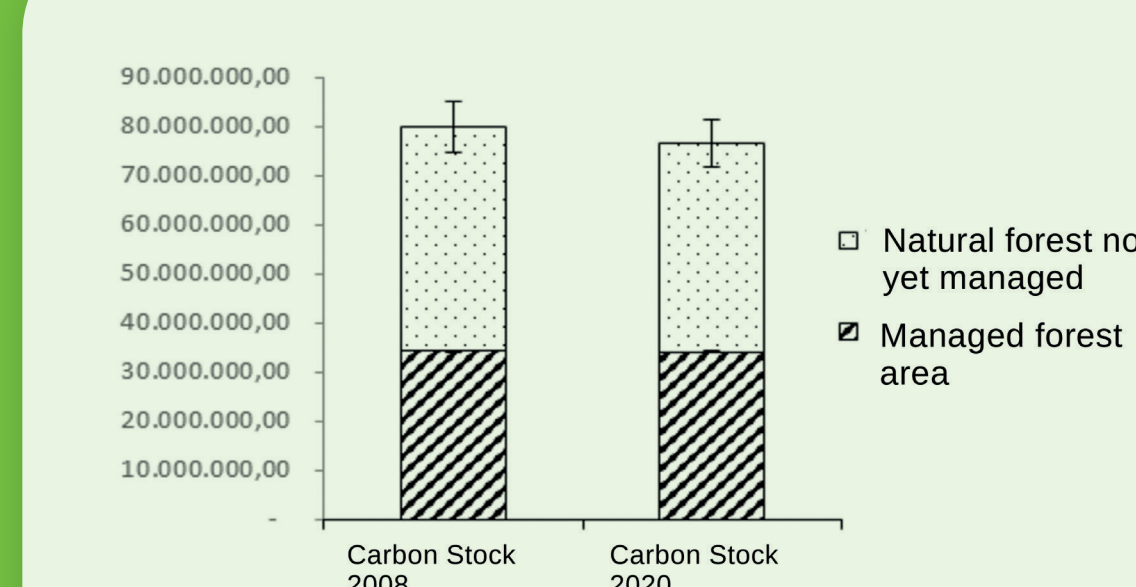


Figure 2

Figure 2: Variation of Carbon Stock, of aboveground biomass, in tons (CV = 11.1%) in the years 2008 and 2020 in the forests of Precious Woods - Mil Madeiras Preciosas, State of Amazonas, Brazil.

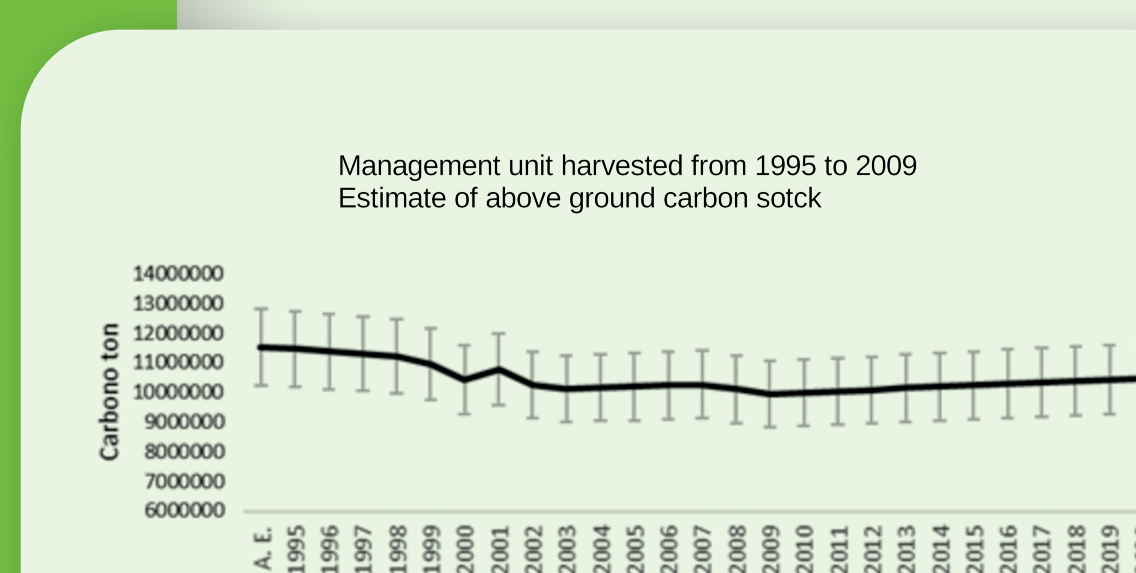
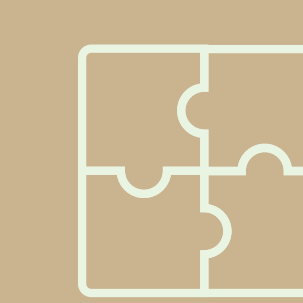


Figure 3

Figure 3: Graph of the variation of Carbon Stock of aboveground biomass, estimated in tons (CV = 11.1%) for natural forest before logging (A.E.) and for subsequent years in the SFM unit "Dois Mil" harvested from 1995 to 2009. SFM area of the company Precious Woods - Mil Madeiras, State of Amazonas, Brazil.

Conclusions

- Through the present value of 76,508,299.03 tons (161.47 t.ha⁻¹ ± 14.4) of carbon in 2020, compared with the 2008 value of 79,864,225.27 tons (168.56 t.ha⁻¹ ± 14.4), it can be said that the carbon stock was statistically equal in the two periods studied.
- The evidence presented in Figure 3 (the first production units harvested from 1995 to 2009) clearly demonstrates that carbon stocks recover after harvesting and are maintained over the years. This is mainly achieved through silvicultural activities under SFM, guaranteeing the protection of forest cover in those areas.
- The FSC Ecosystem Services Procedures were successfully applied in 2020 but do still not generate any financial compensation.



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