Contribution to the GST1/SB003/COP27

CDR as ITMO.

Abstract

Over the next decades there will be an increase on global demand for biomass and GHG emissions` reduction, and intensification of land use is the most promising solution – together with processing efficiency - for balancing HANPP consumption with NPP from atmospheric CO2 fertilization. Forest plantations, croplands, cultivated pastures, lianas, palms and other secondary vegetation have shown yield gains from CO2 fertilization, while trees respond somehow at first, losing the capacity afterwards. There is evidence showcasing a path of native tropical forest degradation given atmospheric CO2 fertilization, which is mainly due to favoring secondary vegetation competitiveness against trees at un-managed standing stocks. Following the BAU scenario, tropical forest should become less and less covered with trees over the next century. An alternative IFM scenario is proposed, where contemporary silviculture techniques can reverse the process and produce HWP and NTFP as result of land use intensification. This will generate additional atmospheric CO2 removals certifiable as CDR goods, which are able to generate carbon credits for financing the reduction of secondary vegetation and promote cultivation of improved native tree species. These CDR credits can be included at tropical countries` NDC and presented at UNFCCC as an ITMO for fighting global climate change.

Keywords: Tropical Forest, HWP, IFM, CDR, NDC, ITMO,

1. Introduction

CDR (Carbon Dioxide Removal), are anthropogenic activities that remove CO2 from the atmosphere and store it in a durable way in geological, terrestrial, oceanic reservoirs or in products, Includes existing and potential anthropogenic enhancement of biological or geochemical sinks and direct air capture and storage, but excludes natural absorption of CO2 not directly caused by human activities. The latest report from Working Group III (WG III) of the Intergovernmental Panel on Climate Change (IPCC) includes CDR to counterbalance hard-to-abate residual emissions (AGGARWALA, 2008). In the European Union (EU), the European Climate Law commits the Union to reach climate neutrality by 2050. Both greenhouse gas (GHG) emission reductions and CDR will be needed to achieve the objective of climate neutrality by 2050. The European Green Deal includes rules on certifying carbon removals to expand sustainable carbon removals and encourage the use of innovative solutions to capture, recycle and store CO2 by farmers, foresters and industries (EC, 2022). Carbon removal certification is proposed as a potential preamble to establishing a carbon trading system for land sector removals, from 2030 (EU Parliament, 2022). In the USA, Assembly Bill A8597 NYS, Enacts the carbon dioxide removal leadership act. § 76-0103, establishing a market for certified CDR of a minimum of 0.1M tCO2e in 2025 and which can reach up to 60M tCO2e/year, at a maximum price of US$ 350 / tCO2e (NYS, 2022). Industrial topical hardwood timber is a clear example of a high-quality CDR, coming from forestry, on of the best available Nature Based Solutions NBS.

In the next four decades, population is expected to grow by 40%, the world economy by a factor of 3, and agricultural production by 60–100%. The capacity of land to produce biomass is one critical limiting resource, and humans can influence through inputs and management, resulting on large Net Primary Production (NPP). Biomass provides humans with food, fiber, and fuel, and generates the terrestrial carbon sink that helps to hold down climate change. Total human Appropriation of Net Primary Production HANPP has grew from 13% in 1910 to 25% in 2005. Global biomass harvest ($HANPP_{harv}$) and consumption of biomass products have risen in almost perfect correlation with global population growth[1]. Over the 20th century human induced land use productivity was the main responsible for reducing global HANPP from 2.1 to 1.6 t, meaning that less biomass production is needed to supply 1 t of biomass for human use. By increasing yields over the last 50 y, farmers brought cropland closer to replicating the productivity of native vegetation[2]. At cultivated pastures, in 1961 there were 29 tons of grazed biomass (dry matter) used for the production of 1 ton of animal products; by 2005, this ratio was down to 17. Asia, Africa, and Latin America experienced[3] the expansion of agriculture and cropland yield gains[4], increased from 41% to 69%[5]. By contrast with cropland and cultivated pastures, land use efficiency of natural pasture and native forest did not increase with a $HANPP_{luc}$ = zero for woodland and for nondegraded natural grasslands. Although the importance of rising yields has been well known, HANPP provides a useful measure of these efficiency gains because it equates all crops based on their carbon content, relates it to the productivity in global land ecosystems and, hence, demonstrates the magnitude of human-induced changes to the global carbon cycle (Krausmann et all, 2013 in Tomasik, 2018).

Human induced land use improves HANPP also in the tropics. At the tropics there are large availability of hardwoods. Tropical hardwoods are more durable, rot and marine animals resistant, stronger and cheaper than overall global hardwoods (AGGARWALA, 2008) competing on the markets. They are the ones with the largest

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[1] "HANPP" is the total carbon produced annually by plant growth. Total HANPP, measured in units of carbon, is the sum of two subcategories: $HANPP_{luc}$ and $HANPP_{harv}$. $HANPP_{harv}$ is the quantity of carbon in biomass harvested or otherwise consumed by people, including crops, timber, harvested crop residues, forest slash, forages consumed by livestock, and biomass lost to human-induced fires. $HANPP_{luc}$ is the change in NPP, also measured as annual carbon flow, as a result of human-induced land use change. The calculation of $HANPP_{luc}$ requires the estimation of the NPP that would be generated by the potential natural vegetation if vegetation were left unaltered - NPP_{pot}[1]. From NPP_{pot}, we can also calculate HANPP as a percentage of the potential productivity. Global HANPP measured in GtC/y grew by 116% and by 2005 reached 14.8 GtC/y. As a percentage of the potential plant growth of native vegetation (NPP_{pot}),

[2] which meant that $HANPP_{luc}$ decreased

[3] very high growth rates in HANPP; as a percentage, HANPP doubled or even tripled in these regions during the last century. With

[4] measured in $HANPP_{harv}$ on cropland as a ratio of NPP_{pot},

[5] That increase, spread out over all cropland in 2005, generated 2.5 GtC/y of crops, which met 49% of the total increase in human consumption from 1910.

lifespan between timbers, which make them very attractable to consumers wishing to have long term, colorful, fragrant wood at their homes, offices and industries. When it comes to forestry and the tropics, the role they can play on removing atmospheric CO2 and turning into industrial and energy wood, might influence decision making towards NDC (National Determined Contributions) to include CDR as part of goals to reach carbon neutrality.

The consumption of tropical timber products would help reducing the overall carbon footprint of construction globally, supplying woods with large lifespan enhancing the Society stocks of carbon. Tropical forestry productivity is directly linked to silvicultural practices, what is observed is a forest biological reaction to silvicultural treatments determining short- and long-term productivity and stocks increase. Replacing natural regeneration by human induced silviculture increases standing stocks and summed up the positive effects of contemporary techniques elevates harvesting volumes. In the world circa of ¾ forest plantation are from country`s native species (ZANETTI, 2015). Increasing productivity is a way to remove atmospheric CO2 and transform it into industrial and energy wood, both can be certified as CDR. This tropical industrial and energy hardwoods certified as CDRs can contribute to reduce emissions at consumers end. Tropical wood CDRs are goods which include carbon credits, and can be used by consumers to reduce their overall GHG negative balance towards consumption.

2. Tropical Forestry and HWP

According with FAO (Food and Agriculture Organization), Degradation is translated as: “change between forest classes (f.e. from “close” to “open”) which negatively affects the site and, in particular, reduces its productivity capacity[6]. Intergovernmental Panel on Climate Change - IPCC2006 guidelines for GHG inventories from different sectors includes accounting procedures for Dead Wood – DW and Harvested Wood Products - HWP[7]. Because of this, wood used within project activity boundaries for fencing, furniture, construction, energy and others must be accounted as DW when determining forest areas carbon sequestration and storage, including from those without a formal Sustainable Forest Management Plan – SFMP. At those areas holding SFMP the rule is the same regarding DW, and besides this logs, timber, firewood and others imports and exports are also to be accounted for as HWP for the balance of forest carbon areas carbon sequestration and storage (Zanetti, 2017).

At harvesting a large portion of aerial biomass carbon is transferred to HWP (Harvested Wood Products) and will be available at one of the forest products categories. Forest areas biomass volume is used as starting point for HWP carbon estimates, applying specific conversion factors for each log destination. Estimates

[6] Deforestation means: “changing on land use with reduction of tree crow cover below 10% by hectare” while

[7] Within IPCC2006 Dead Wood (DW) is classified as all kinds of branches, leaves, roots, dead trees and other types of biomass not included as litter or soil. Harvested Wood Products (HWP) are all wood material leaving project activities boundaries – other materials remaining within boundaries are to be accounted as DW.

related to wood products baseline are available under the format of volumes delivered to industrial plants or in terms of their outputs, comprising industrial logs or primary HWP (boards, planks, panels or paper). Carbon availability at those HWP over the years is estimate allocating other parameters which indicate carbon amount 'in use' and destined to landfills. HWP Carbon estimates Recycling inclusion relays upon data availability[8].

Globally forests store circa of 8.4 billion tCO2e and are capable of retaining some further billions, while 4.2 to 20 billion tCO2e are estimated to be stored within HWP "in use"[9]. The 3.4 billion m3 of yearly global harvested wood is equivalent to just 20% of total yields (some 17 billion m3 / year). A lot from what is harvested becomes used for direct and inefficient burning as fuel wood. Increasing the biomass amount taken from forests and harvesting yields would have a profound positive effect to fight global warming. With the use of extra 2 billion m3 / year industrial woods will be possible to reduce between 14 and 31% of all cement and steel GHG emissions and between 12 to 19% of all fossil fuel consumption by the use of residues from industrial wood production chains for clean energy appliances. With the intensification of sustainable forest management more CO2 is sequestered and stored avoiding emissions from alternative materials and still producing renewable energy from harvesting residues. Besides, harvested volumes are renewed. Brazil has by far the largest global stock and growth of "hardwoods" which have the longest life-spam between tree species, making them relevant suppliers of HWP storing carbon for many years.

"Tackle Climate Change: Use Wood" is a European Parliament program directed to strength societal use of wood as a way of fighting atmospheric CO2 accumulation. France has "de Bois-Construction-Environment", England the "Wood for Good", Netherlands "Centrum Hout", Denmark "Trae Information", Finland "Puuinfo", Belgium "Wood Forum", Spain's "Viver Con Madera", Australia "Wood Naturally Better" and Austria and Italy "Promo Legno" are few from national, binational and multilateral networks for the promotion of wood use as a form of global climate change mitigation. International Wood Culture Society (IWCS) is a non-profit organization formed by wood enthusiasts, dedicated to research, education and promotion of wood culture. IWCS advocates for a harmonious living between people and nature, explores the value of wood use from a cultural perspective and supplies a platform for studying wood culture, encouraging its practice and promotion. IWCS established March, 21st as Wood World Day, a data to disseminate the value wood aggregates to daily life (Zanetti, 2017).

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[8] Estimates of forest products contribution, in terms of carbon, use generic variables, including (i) domestic HWP and imports (tCO2e / year); (ii) annual variation of HWP produced domestically, including annual variations on exported HWP (tCO2e / year); (iii) annual imports of all kinds of wood and paper (tCO2e / year); (iv) annual exports of all kinds of wood and paper (tCO2e / year); and (v) annual HWP (tCO2e / year). The level of lost on solid products and paper, in a given year, are specified towards the use of a lost constant (k), which by convenience is expressed in terms of half-life in services, in years. Half-life in service describes the number of year necessary for half of the material to change environment, which can be, for example, from a home to landfill, within that sector where it remains stored. Solid wood and paper production, imports and exports are converted from m3 or tons into tCO2e.For annual estimates calculation the method uses yield data (Consumption = Domestic Production + Imports – Exports).

[9] World wood production includes more than 1.5 billion m3 / year of industrial logs, accounting for something like 1.1 billion tCO2e / year, with 420 million m3 of sawed lumber and 220 million m3 on plywood and panels - representing some 20% of total in long life-spam forest products, which sequester and store close to 200 million tCO2e each year.

Tropical forestry must be accompanied of similar public and private efforts towards trade and use of tropical hardwoods, creating the synergies that might help removing huge amounts of atmospheric CO2 and returning to society in noble wood products. The current stocks of billions of m3 of dying mature trees ready to harvest on Brazilian Amazon region alone, have the capacity to remove billion tCO2e from the atmosphere, just by turning them into timber and having new trees planted. Cutting down trees to not implicate on GHG emissions, or the change and land use is directly linked to atmospheric CO2 generation. The use of wood could also generate millions of Jobs and trillions of dollars in revenue over the next decades. Tropical forests hold capacity to regenerate after harvesting and the much this would mean is directly related to silvicultural practices, which will impact global GHG balance positively with broad use of tropical HWP.

2.1 Biomass Stocks from 1960`s at the Region

Most data used today are still from old studies carried out by RADAMBRASIL surveys, from the late 1950s to the early 1970s using side-looking airborne radar imagery combined with 1-ha ground plots at approximately 3000 points, often reached by helicopter. Even with these limitations, the use of the RADAMBRASIL surveys[10] is still not easily compensated for by applying more sophisticated remote sensing interpretation to a small set of ground-based plots (Fearnside, 2016).

From this studies, class 8 and class 9 of dense tropical forest at the region used to hold average between 420-480 m3/ha, toping 520-580 m3/ha of tree biomass (Saatch et all, 2007).

2.2 Biomass Stocks today at the region

Usually Continuous Forest Inventory with a proportion of 0.100% (for the effective area) of sampling is used to determined standing stocks volumes and from there, biomass. Size of a number of fixed area plots of 10 meters wide by 250 meters long, used for monitoring the increment and mortality. A diagnostic database was attached to Sinaflor, containing in the digital files the inventory with sampling units, statistical analysis and a list of species found. Today biomass analysis use space-borne LiDAR (Light Detection and Ranging) from the US National Aeronautics and Space Agency (NASA) Geoscience Laser Altimeter System (GLAS) on the Cloud and Land Elevation Satellite (ICESat), together with optical data from MODIS imagery and radar data from the Global Quick Scatterometer (OSCAT). The results show major differences between all of the resulting maps, including those with largely overlapping ground-based datasets. Expanding the network of ground-based inventories is essential. The way forward will require using remote sensing data together with ground-based measurements, with progress needed in both areas (Fearnside, 2016).

[10] has been daunting to many research groups: the reports are a vast labyrinth of over 50,000 pages, written in Portuguese and historically with limited availability at any single location. However, ignoring this enormous body of work represents a loss that

Average biomass of standing stocks range from 248.92 ± 61.78 t/ha, passing by 293.19 ± 27.74 t/ha, and reaching up to 356 ± 47 t/ha (Santos et all, 2018/2018a), based on measurements for trees ≥10 cm DBH (diameter at breast height: diameter at 1.3 m above the ground or above any buttresses) with a 12 % correction for small trees (Fearnside, 2016). Roughly, one can assume 1:1 ratio from biomass to m3, making it 270 to 320 m3/ha and topping 310 to 400 m3/ha, circa of 25 to 35% less volume than 50 years earlier, as stated on the previous item.

3. Carbon Fertilization and Tropical Forestry NPP

The increase in human-induced emissions means that forests worldwide grow faster and reduce the amount of CO2 which stays airborne – an effect known as carbon fertilization. - higher in the tropics. There has been an increasing carbon sink on land since the 1980s, living woody plants were responsible for more than 80% of the sources and sinks on land[11] (Reiny, 2019). Globally, vegetation is locking away more carbon as atmospheric CO_2 levels rise. Plants are growing faster, fueled by a more fertile atmosphere. Carbon *stocks* (i.e., standing plant production) are not the same thing as NPP (i.e., rate of growth of plant production). Increased CO_2 concentrations reduce photorespiration, which translates into greater plant productivity - NPP[12]. Giving plants more CO_2 increased net primary productivity by 24% on average[13]. Factorial simulations with multiple global ecosystem models suggest that CO_2 fertilization effects explain 70% of the observed greening trend[14]. CO_2 fertilization effects explain most of the greening trends in the tropics. Results show a considerable increase in net primary production (NPP) over the last century, mainly due to the CO_2 fertilization effect

Pastures uptake 5-50 tCO2e/ha/year of atmospheric CO2 and also hold Nitrogen, which is turned by each animal into something like 0,5 tCO2e/year of carbon-based products - protein[15]. The methane emissions associated is a result of the balance between the atmospheric CO2 removed by pastures and what gets process through animals' digestive system. The more animals are grazing, the more atmospheric CO2 is turned into protein and other products – including fertilizers (Grise, 2005), resulting on a process of removing the gas and returning into Society as useful goods.

Secondary vegetation like Lianas, palms, bamboo and other non-tree life forms have been omitted from a number of Amazonian biomass studies, often fail to report what components are included[16] (Fearnside, 2016). For Brazil as a whole an average aboveground carbon stock of 120 tCO2e/ha in savanna woodlands

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[11] with soil, leaf litter, and decaying organic matter making up the rest. But they also saw that vegetation retained a far smaller fraction of the carbon than the scientists originally thought.

[12] although warmer temperatures counteract this effect by increasing photorespiration somewhat

[13] Terrestrial Ecosystem Model (TEM) predicts that doubled CO_2 will increase 16.3% of the global NPP. Under real conditions on the large scale where water and nutrient availability are also important factors influencing plant growth, experiments show increases under unstressed conditions.

[14] followed by nitrogen deposition (9%), climate change (8%) and land cover change (LCC) (4%)

[15] while returning fertilizers and gases to the environment

[16] Standardization for non-tree components, together with trees <10 cm DBH, removes almost all of the difference between aboveground live biomass.

classified as “forestland”[17], and 45 tCO2e/ha in those classified as “shrublands” (65.6 % of the area), giving a weighted average of 75 tCO2e/ha[18] (Fearnside, 2016).

Net primary productivity (NPP) of a closed-canopy[19] forest stand was assessed for three years in a free-air CO2-enrichment (FACE) experiment. NPP increased 21% in stands exposed to elevated CO2, and there was no loss of response over time. Wood increment increased significantly during the first year of exposure, but subsequently it came back to original levels, reducing the potential of the forest stand to sequester additional C in response to atmospheric CO2 enrichment[20] (Norby et all, 2002). Current there is limited pool of knowledge regarding the long-term enrichment of CO2 impacts in tropical rainforests (Yang, 2016). Young trees and other small plants responded well to higher CO_2, but it remains undetermined how more mature trees would react. Brazilian Amazonian trees are dying faster than they're growing. On land, reports suggest a decline in the tropical sink, increased plant mortality and decreased plant productivity. Under low Nitrogen conditions[21], plants will have difficulties to transform elevated CO_2 into production[22] (Krausman et all, 2013 in Tomasik, 2018).

Standing Undisturbed tropical forest sites over the last 50 years lost total volume of trees to secondary invasive vegetation, making them naturally net emitters of CO2. When this behavior is kept, in the next 50 years tropical sites are to loose yet another part of its stocks volume to the increasing competition of secondary vegetation. With this, large protected areas at isolated areas in the Amazon region kept um-managed should hold yearly less volume than managed and plantation ones. The CO2 fertilization is uptake much faster by secondary vegetation and the trees are losing their competitiveness every year, without harvesting and silvicultural treatments. As in Table 1, following the current BAU (Business As Usual) scenario and considering a 400 years’ time frame, tropical forests are going to become less and less tree covered as the CO2 levels raise and no intervention is done:

[17] 34.4 % of the total savanna woodland area

[18] Conversion from the original text in Mgha-1 using 1:1 ratio for m3, and 3,67 factor for C-CO2

[19] Liquidambar styraciflua (sweetgum)

[20] Most of the extra C was allocated to production of leaves and fine roots. These pools turn over more rapidly than wood,

[21] CO_2 may not much affect plant productivity because of lack of Nitrogen in the soil. plant acclimatization and water availability

[22] Moreover, in the long term, elevated CO_2 condition may cause the accumulation of carbohydrates in the plant tissues which may reduce the photosynthetic rates or decrease photosynthetic response to elevated CO_2.

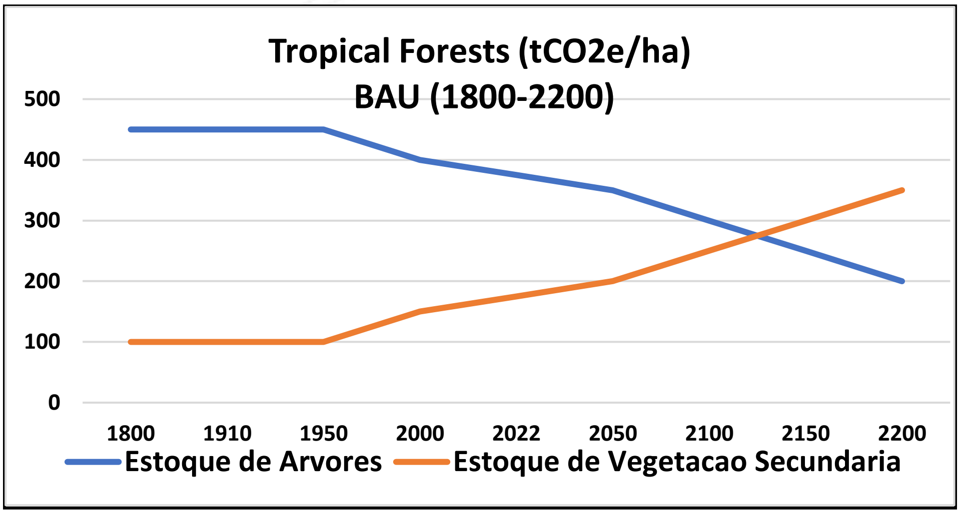

Table 1: Tropical Forests standing stocks BAU scenario over 400 years

Secondary vegetation gains competitiveness over trees as the atmospheric CO2 becomes more and more available, reducing the overall carbon stock of the stands. The process is ongoing and tends to speed up with the increase of CO2 and reduction of tree cover, which favors even more secondary vegetation growth. Gains in productivity of secondary vegetation can be compared to those from croplands, and Brazilian agriculture has portrayed continuous productivity increase over the last 30-40 years (EMBRAPA, 2018), showcasing the positive effect of atmospheric CO2 enrichment on plant NPP. Meanwhile the ability of tropical forests trees to absorb massive amounts of carbon has waned (NASA, 2021).

4. Improved Forest Management at the Tropics

Tropical forests are accountable for about 35% of global net primary productivity (NPP)[23]. The CO2 fertilization effect that increases CO2 concentrations in leaves enhances plants' capacity in fixing carbon through photosynthesis has been considered as a primary mechanism that maintains and enhances tropical forest productivity (Wang et all, 2021).

The human appropriation of net primary production (HANPP) provides a useful measure of human intervention into the biosphere. The productive capacity of land is appropriated by harvesting or burning biomass and by converting natural ecosystems to managed lands. HANPP has still risen from 6.9 Gt of carbon per y in 1910 to 14.8 GtC/y in 2005, i.e., from 13% to 25% of the net primary production of potential vegetation. Biomass harvested per capita and year has slightly declined despite growth in consumption because of a higher conversion efficiency of primary biomass to products[24]. The rise in efficiency is overwhelmingly due to increased crop yields, HANPP might only grow to 27–29% by 2050, but providing large amounts of

[23] And store about 72% of global forest biomass carbon (C)
[24] And decline in reliance on bioenergy

bioenergy could increase global HANPP to 44%. This result calls for strategies that foster the continuation of increases in land-use efficiency.
Foundation of Forestry Research from Federal University of Parana (FUPEF/UFPR), introduced the Improved Forest Management (IFM) Measure Report and Verify (MRV) Methodology for carbon credits generation at introduced or native tree species reforestation and / or revegetation project activities for the increased productivity of harvested wood products – timber and non timber – from existing forested areas within rural properties. Eligible activities under IFM include those directly influenced by man and which indicates an increase in the carbon stock or productivity of the areas; and the consumed HWP should lead to a reduction in emissions or an increase in CO_2 removals. (FUPEF, 2022).

Harvesting and consumption of tropical timber products stimulates productivity, reverting the degradation process due to increase of secondary invasive species volume, and generate profits. With a profitable forestry activity in place there is incentive to practice forestry and reduce conversion to other land uses. Therefore, tropical timber is a value added CDR that can reduce forest degradation and conversion of forestry to other land uses, while increasing CO_2 removals. Advanced silvicultural techniques can be applied to improve productivity (Zanetti, 2012), taking advantage of the CO_2 fertilization. As in Table 2, following Improved Forest Management (IFM) contemporary silviculture techniques, the scenario considering a 400 years' time frame shows tropical forests recovering tree volume against the competing secondary vegetation:

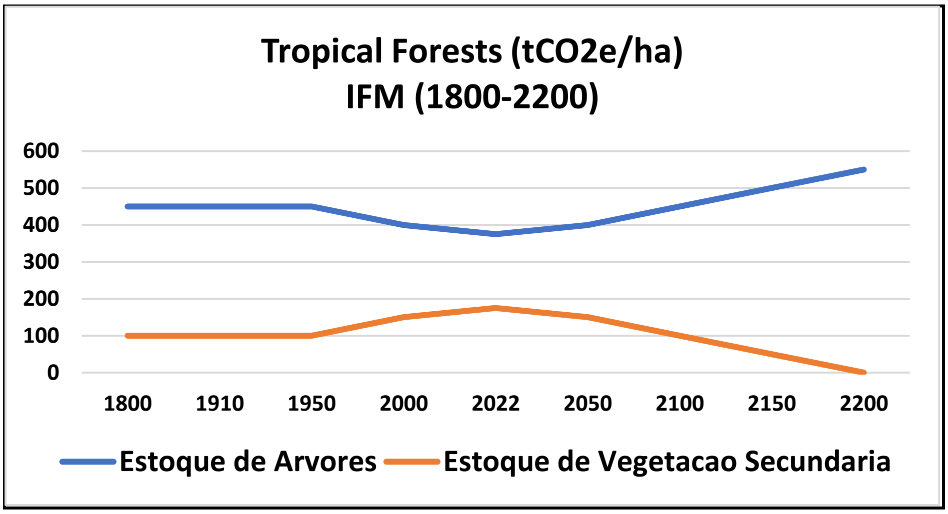

Table 2: Tropical Forests standing stocks IFM scenario over 400 years

Silvicultural practices – planning, individuals' selection, seed collection, genetic improvement, seedling, fertilization, maintenance, weed, insects and diseases control, harvesting - are applied to reduce the presence of secondary vegetation and introduce CO_2 enriched environment adapted trees` varieties. This will result in increasing yields and therefore reducing HANPP while supplying society with more industrial and energy wood and other Non-Timber Forest Products

(NTFP). The positive effect of IFM techniques are widely known globally, and promoted the cultivation of native tree species all over the world (Zanetti, 2015).

Brazil holds the largest stock of hardwoods in the planet. Some of those tropical hardwoods have characteristics that make them therapeutic, comfortable, charming as well as immune to fungi and insect attacks. Brazilian tropical hardwoods, just as softwoods, possess a diversity of qualities which are hard to be reached by any other tree species in the world. Those unique qualities are competitive advantages that can be used to enhance Amazon biodiversity cultivation tropical timber consumption role. With a growing and promoted consumption increase, rural landholders have markets available to justify necessary investments on Brazilian native tropical timber species cultivation, with the use of IFM[25] (Zanetti, 2017).

5. Tropical Forestry and the Certification of HWP - CCU and CDR

As the world in the next few decades faces further increase in global population and economic output resulting on large new demands for food, fuel and fiber, stresses the importance of developing improved practices for sustainable intensification of land use. Production of CDR from increasing forest and HWP atmospheric CO2 removals copes at the same with reducing emissions targets, making it a highly competitive credit for global carbon markets. CDR production also represents a significant opportunity to private investors on engaging at Environmental and Social Governance ESG activities and into the international carbon markets. Registered carbon credits can supply an income source for landowners, support rural development and facilitate IFM implementation. Logs produced to supply industry with sustainable sources can receive payments directed to improve technology at silviculture, trade and finance towards inclusion of payments for carbon credits. When tropical timber used by society comes from sustainable origins it increases forestlands atmospheric CO2 removal capacity.

Production and consumption of tropical timbers need to be within the framework off accepted CDR for global carbon Market development at countries ‘National Determined Contribution (NDC) to UNFCCC. Countries around the globe could include tropical timber products as CDRs and purchase these credits as part as the acceptable contributions – Internationally Tradeable Mitigation Opportunities (ITMO) to halter forest degradation and land use change. With Tropical HWP accepted as CDR, global carbon markets can promote increase of carbon stocks within Society as a way to reduce global GHG emissions (from cement, iron etc) and increase removals of atmospheric CO2 at the same time. The more tropical timber is consumed, the better for the climate. The same goes for all tropical agriculture and pastures products, which are carbon-based products resulting from up taking atmospheric CO2 and turning it into useful goods for humanity.

[25] biodiversity banking regional strategies implementation and the use of contemporary industries (MDF, HDF etc) value aggregation will increase social inclusion chances and, by that, project activity sustainability over time

The Bioeconomy of Brazilian Amazon ecosystems sustainable management relays upon technological interventions. With investments directed to appropriate silvicultural technologies, national wood products from Brazilian native tropical timbers will be highly competitive at international Green Economy markets. Brazilian tropical timber species diversity, productivity and qualities being cultivated under contemporary silvicultural techniques are capable of placing native forest sector amongst world`s greatest. Native forest species biodiversity cultivation contribution from the use of Brazilian woods will be a direct result from consumption incentives. National regulations must incentive the use and consumption of native timber from sustainable sources as a way of assuring forest biodiversity cultivation sustainability.

6. Conclusion

Over the next decades there will be an increase on global demand for biomass and GHG emissions` reduction, and intensification of land use is the most promising solution – together with processing efficiency - for balancing HANPP consumption with NPP from atmospheric CO2 fertilization. Forest plantations, croplands, cultivated pastures, lianas, palms and other secondary vegetation have shown yield gains from CO2 fertilization, while trees respond somehow at first, loosing the capacity afterwards.

There is evidence showcasing a path of native tropical forest degradation given atmospheric CO2 fertilization, which is mainly due to favoring secondary vegetation competitiveness against trees at un-managed standing stocks. Following the BAU scenario, tropical forest should become less and less covered with trees over the next century. An alternative IFM scenario is proposed, where contemporary IFM silviculture techniques can reverse the process and produce HWP and NTFP as result of land use intensification. This will generate additional atmospheric CO2 removals certifiable as CDR goods, which are able to generate carbon credits for financing the reduction of secondary vegetation and promote cultivation of improved native tree species. These CDR credits can be included at tropical countries` NDC and presented at UNFCCC as an ITMO for fighting global climate change.

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