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Gas Mitigation in Paper Production

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Abstract. The Brazilian paper industry has competitive advantages offered by the favorable climate, which favors an increase in the yield of forest restoration, and consequently, in the productive process. On the other hand, following the greenhouse gases (GHG), we can see our constantly changing sun, causing the solar storms, allowing their prevention or mitigating measures. The objective of this work is to contribute to the construction of the understanding necessary for the reduction of GHG emission from a preliminary analysis of the pulp and paper sector. As a secondary objective, the text preliminarily analyzes a company's behavior against the backdrop of the Paris Accord, which strengthens the global response to the threat of climate change and strengthens the capacity of countries to deal with the impacts of such changes. The identification of best practices in the pulp and paper industry is understood, focusing on environmental sustainability, such as the adoption of reforestation, obtaining significant results. In the case of the paper industry, the management of public forests for sustainable production, within the structure of the Ministry of the Environment, establishes the promotion of public awareness about the importance of conservation, recovery and sustainable management of forest resources.

1. Introduction

Paper is considered the main support for the diffusion of writing, information and all human knowledge. Before the discovery of paper, man used the most different materials for the record of his existence, such as leaves, bark, leather, cloths, stones, clay and metals. The paper appeared in China at the beginning of the second century, invented by T'Sai Lum, an officer of the Court who would have fabricated the paper from the cortex of plants, old textiles and fragments of fishing nets. [1].

The company Fibria was chosen for the job, as a potentially polluting company, we will analyze the Environmental Performance Index (IDA), which is a tool that evaluates the quality of the processes in



the industry through indicators such as pollution prevention and control and environmental management, verifying that it is actually meeting the Forest Code with the restoration in the field.

This work has as objective:

1. Contribute to the construction of the understanding necessary for the reduction of greenhouse gas emissions (GHG) from the pulp and paper sector.
2. Preliminary analysis of the behavior of a company against the scenario indicated by the Paris Agreement.

Part of the solar energy that comes to the planet is reflected directly back into space, reaching the top of the Earth's atmosphere, and part is absorbed by the oceans and the Earth's surface, promoting its heating. A portion of this heat is radiated back into space, but is blocked by the presence of greenhouse gases that, despite passing energy from the Sun (emitted at smaller wavelengths), are opaque to terrestrial radiation emitted in larger Wavelengths. This difference in wavelengths is due to differences in the temperatures of the Sun and the Earth's surface.

The presence of these gases in the atmosphere makes it habitable, because if they did not exist naturally, the average temperature of the planet would be very low, on the order of minus 18°C. The energy exchange between the surface and the atmosphere maintains the current conditions, which provide an average global temperature near the surface of 14°C. [2].

Our ever-changing sun releases solar material into space. The grandest events are massive clouds emerging from the sun, called coronal mass ejections (CME). These solar storms come first with some kind of warning - the flash of a bright flash, a blast of heat or a flood of solar energy particles. But another kind of storm has puzzled scientists for their lack of typical warning signs: They seem to come out of nowhere, and scientists call it a stealthy CME. [3].

To discover the origins of stealthy CME, scientists have developed a model of the sun's magnetic fields, simulating its strength and motion in the sun's atmosphere. Central to the model was the differential rotation of the sun, which means different points about the sun rotating at different speeds. Unlike the Earth, which rotates like a solid body, the sun rotates faster at the equator than at its poles. [3].

Earth's magnetosphere is created by our magnetic field and protects us from most of the particles the sun emits, these solar eruptions are difficult to predict and may interact with space weather effects.

Space time studies provide us with the ability to predict events and conditions in the Sun and near Earth, preceding precision to allow for prevention or mitigating measures to be taken.

The results of global assessments of the Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change (IPCC 2001) Working Group 2 (WG2) on impacts, adaptation and vulnerability to climate change at the regional level can be summarized as follows:) Recent climate changes, especially rising temperatures, are already affecting physical systems (climate, water resources) and biological systems (ecosystems, human health, cities, industries); B) Preliminary indicators exist that some human systems have already been affected by drought or floods; C) Natural systems are vulnerable to climate change, and some will be irreversibly damaged; D) Those with less resources and less able to adapt are the most vulnerable. [4].

Although Brazil's contribution to the global concentration of greenhouse gases is lower than that of the industrialized countries, and contribution due to fires (smoke and aerosols) are quite high. Projections of climate models allow the generation of climate scenarios in the future, but it does not yet distinguish or separate the effects of natural climate and man-induced variability. [4].

The Brazilian Association of Trees (IBÁ) identified growth in its volume of exports of the three segments analyzed, ie pulp, wood panels and paper, compared to the same period of the year 2015. IBÁ identified a positive result, Which is reflected in the trade balance of the forestry sector, which reached US \$ 6 billion, representing growth of 2.3%. [5].

In the same period, Brazilian pulp production reached 17.1 million tons and paper pulp 9.5 million tons. The main destinations for Brazilian exports of paper and wood panels are Latin American countries. In the case of Brazilian pulp, the largest importing country in 2016 was China. [5]

Brazilian pulp production rose 4.8% in January 2017 over the same period in 2016 to 1,665 million tons, with exports of the raw material rising 47.4% in the same comparison. Sales of wood panels in the country, an important input for civil construction, rose by 7.6% in January from 1 year earlier, to

508,000 m³. Paper production in January fell 0.5% from a year earlier to 862,000 tonnes, with domestic sales falling 4.9% in the same period to 424,000 tonnes. [6].

Based on these data, we can observe the growth of the Gross Domestic Product - Brazilian GDP, together with the GHG, in evidence the carbon due to the materials used, the association of the industries has great potential to contribute to the positive interferences to the climatic changes, seeking to exploit this market for a low carbon economy.

2. Comparison between Brazilian Production and that of Other Countries

Currently, the most used vegetable raw material in papermaking is wood, although others may also be used. These raw materials are now processed chemically or mechanically, or by a combination of the two modes, generating as a product what is called cellulosic pulp, which can be further bleached if a white pulp is desired. The cellulosic pulp is composed of the cellulosic fibers improving the bond between them, after undergoing a thinner purification to separate the existing sands in the pulp. Finally, the pulp is bleached with chlorine or peroxide compound following to the papermaking machines. [7]. China and the United States, despite being the largest producers, do not produce enough to meet domestic demand. Brazil is in 4th place among the world's largest pulp producers, is expected to climb to third place, surpassing Canada in the next six years, according to the plan to expand production in the country. [8]. (see Table 1)

Table 1. The 10 largest pulp producers in the world.

Position	Country	production
1 °	United States	18. 308 tonnes
2 °	China	19.542 tonnes
3 °	Canada	18. 308 tonnes
4 °	Brazil	13.922 tonnes
5 °	Sweden	11.859 tonnes
6 °	Finland	10.363 tonnes
7 °	Japan	9.020 tonnes
8 °	Russia	7.453 tonnes
9 °	Indonesia	6.805 tonnes
10 °	Chile	4.876 tonnes

Source: (Lairtes Chaves, 2012)

Table 2. In 2012, the 10 largest countries that emit greenhouse gases account for more than two-thirds of total global emissions. [9]. (see Table 2)

Position	Country	Production	%
1 °	China	10.684.29 MT CO ₂ e	22.44%
2 °	United States	5.822.87 MT CO ₂ e	12.23%
3 °	European Union	4.122.64 MT CO ₂ e	8.66%
4 °	India	2.887.08 MT CO ₂ e	6.06%
5 °	Russia	2.254.47 MT CO ₂ e	4.73%
6 °	Indonesia	1.981 MT CO ₂ e	4.16%
7 °	Brazil	1.823.15 MT CO ₂ e	3.83%

8 °	Japan	1.207.30 MT CO ₂ e	2.53%
9 °	Canada	856.28 MT CO ₂ e	1.79%
10 °	Mexico	748.91 MT CO ₂ e	1.57%

Source: (Johannes Friedrich, Mengpin Ge and Thomas Damassa, 2015).

3. From the Paper Industry, from the Brazilian Industrial Park

Brazil is the first producer of e pinus eucalyptus pulp, where sanitary products are manufactured: toilet paper, disposable diapers, absorbents and napkins, among other related items, called short fiber pulp. The favorable climate had a great role in the development of the national tree engineering, and with that, the high forest yield of Brazil added to the exchange advantage. [10].

The 2010 greenhouse gas inventory of Brazil shows that the total amount of carbon dioxide (CO₂) launched by the country is reduced by 50% between 2005 (previous inventory) and 2010, from 2.73 billion tons of CO₂ to 1.27 billion tonnes. By the calculation, in 2005, when deforestation in Brazil was at its peak, 2.73 billion tons of CO₂ were emitted, in the second inventory 2.1 billion tons of CO₂ were accounted for. In 2005 it was the base year used by the government to propose greenhouse gas emission reduction targets submitted to the Paris Agreement. [11].

Paper and pulp companies should be oriented towards a production with sustainability in the economic, environmental and social aspects that need to interact as a whole, to guarantee the permanence of the business, without compromising the environment. [12].

The Agreement recognizes that climate change is a common concern of mankind and requires broad cooperation from all countries to accelerate the reduction of global GHG emissions. To contribute to the mitigation of GHG emissions and sustainable development, it shall establish under the authority, guidance and meeting of the Conference of the Parties to the Paris Agreement its supervision.

The Paris Agreement was approved by the 195 UNFCCC Party to reduce greenhouse gas (GHG) emissions in the context of sustainable development. To strengthen the implementation of the Convention, including its objective, which aims to strengthen the global response to the threat of climate change. The commitment is to maintain the overall average temperature increase below 2°C above pre-industrial levels and to make efforts to limit this temperature increase to 1,5°C in relation to pre-industrial levels, That this would significantly reduce the risks and impacts of climate change. [13]. After approval by the National Congress, Brazil concluded, on September 12, 2016, the process of ratification of the Paris Agreement. On September 21, the instrument was delivered to the United Nations. As a result, Brazilian targets were no longer intended and became official commitments. Now, therefore, the acronym has lost the letter "i" (from English, intended) and is now called the NDC only. [13].

4. Company Studied Fibria

The planted trees sector will play a key role in the goals of the Paris Agreement, the Brazilian partnership becomes part of the agreement, which sets the commitment for low carbon emissions, Brazil becomes the third major issuer to confirm the participation of the treaty.

The Fibria company is part of this sector together with IBÁ, the solution passes through planted forests, with a 100% renewable base, it is estimated that the mitigation potential of the effects of climate change is directly proportional to the capacity of creation and use of mechanisms in the Carbon market, together with integrated and coordinated public policies.

With the Forest Code, the company becomes a producer of renewable and sustainable forests, developed for the production of pulp and paper. The results are expected as a result of the possibility of evaluating the identification and management of its operation risks, its aspects and impacts to the environment Environment, society, health and safety of professionals and the quality of its products and services. The company has developed a prevention strategy aligned with the recommendations of the Kyoto Protocol, the UN Conference of the Parties (COPs) and the National Policy on Climate Change, among other forums.

The IDSA is the tool that the company uses to identify good practices and fragilities related to the socio-environmental performance of the Forest area, promoting maintenance and joint improvements through the interaction of the environment with the operational areas.

Seeking to anticipate and address the legitimate concerns of stakeholders before requiring costly mitigation measures. Identifying environmental or social improvements in forest management, pulp production and logistics that also provide financial gains. Anticipating as much as possible potential issues and risks, gaining time for planning and financing (important in the pulp industry) when changes are needed. [14].

By making use of the treaty signed with the Paris Agreement with Brazil, the company undertakes to:

1. Publish annually the inventory of emissions of greenhouse gases (GHG) of companies, as well as actions for mitigation of emissions and adaptation to climate change.
2. Include as strategic orientation in the investment decision-making process the choice of options that promote the reduction of GHG emissions in processes, products and services.
3. Seek the continuous reduction of specific GHG emissions and the net balance of CO₂ emissions of companies through actions to directly reduce emissions in production processes, investments in carbon capture and sequestration and / or support for reduction actions Emissions from deforestation and degradation. [15].

5. Gas Control Legislation

With a production capacity of 5.3 million tons per year, the company has industrial units located in Aracruz (ES), Jacareí (SP) and Três Lagoas (MS), in addition to Eunápolis (BA), where Veracel maintains joint- Operation with Stora Enso. The company has 969 thousand hectares of forests, 568 thousand ha of planted forests, 338 thousand ha of preservation and environmental conservation areas and 63 thousand ha for other uses. The pulp produced by Fibria is exported to more than 40 countries. [16].

Brazilian environmental legislation is quite sophisticated and old, we can highlight Law 6.938 of August 31, 1981, which establishes the National Environmental Policy (PNMA) and Decree No. 99,274 of June 6, 1990, which regulates it. Among the guidelines established by it are: The establishment of environmental quality standards; The assessment of environmental impacts; and The licensing of polluting activities.

Established by Law No. 12,187 of December 29, 2009, the National Policy on Climate Change (PNMC) establishes its principles, objectives, guidelines and instruments.

State Law No. 13,798 of November 9, 2009, the State Policy on Climate Change - PEMC, regulated by State Decree No. 55,947, of June 24, 2010, is in line with the UN Climate Convention and the National Policy on Climate Change. Climate Change.

The National Plan for Adaptation to Climate Change, as established by Ordinance No. 150 of May 10, 2016, is coordinated by the Technical Adaptation Group, created with the function of providing technical and political guidance for actions under this Plan, Monitor it, evaluate it and review it, as well as establish the detailed routines and operational mechanisms for its management. [17].

Law No. 11,284 of March 2, 2006, the Public Forest Management Law, which provides for the management of public forests for sustainable production, establishes the Brazilian Forest Service (SFB), within the structure of the Ministry of the Environment, and creates the National Forest Development Fund (FNDF). Article 2 establishes the principles of public forest management, which may mention the protection of ecosystems, soil, water, biodiversity and associated cultural values; Promotion of local processing and encouragement of increased value added to forest products and services as well as industrial diversification, technological development, use and capacity building of local entrepreneurs and regional labor; The promotion of awareness and the promotion of public awareness about the importance of conservation, recovery and sustainable management of forest resources.

The Forest Code, reformulated in October 2012, establishes general norms on vegetation protection, Permanent Preservation areas and Legal Reserve areas; Logging, supply of forest raw materials, control of the origin of forest products and control and prevention of forest fires, and provides economic and financial instruments to achieve its objectives.

Subak [18], evaluated the pulp and paper industry worldwide, considering the pulp and paper production process from the removal of wood from the forest to the final disposal in landfills. Fiber supply depends on trees, papermaking requires fuel inputs and paper waste disposal can contribute to greenhouse gas (GHG) and methane (CH₄) emissions, a GHG is twenty times more potent than Or CO₂.

The authors conclude that overall the sector emits around 460 million tonnes of CO₂ equivalent, more than is fixed by the growth of forests, it is estimated that the contribution to global warming of landfill paper is similar to that of [18], as the most significant in the sector's emissions balance, which has achieved important advances in the mitigation of emissions from energy use and biomass disposal, [18] has changed considerably and the results need to be updated to clearly assess the positioning of the Brazilian pulp and paper sector in relation to the current global scenario, but the comparison with the reality of a decade ago is Useful in assessing the correctness and opportunities for improvement that still exist in the sector in relation to GHG mitigation.

Regarding the forest base, the practices adopted with success were the investments in the development of technologies that allowed to reach records of productivity of wood with the use of the natural potentialities of the country. The role of the most recognized forest certification, the Forest Stewardship Council (FSC) and the National Forest Certification Program (Cerflor), endorsed by the International Program for the Endorsement of Forest Certification Systems (PEFC), should be highlighted here. Of the total hectares of trees planted in Brazil, 58% are certified by these entities. [19].

In face of the legislation and norms evaluated, the concern with the environment is identified not only in the present but also in the future. Laws were created to improve resources, certifying companies with sustainable policies, with the Paris Agreement, the partnership with the countries with the same objective was evident, with no measures to be put into practice.

With respect to the generation of GEE, two models prevail that describes the subject, the first one: says to be good for providing conditions for the development of life, through nitrous oxide giving life to the planet. The second against says the first, informing about its impacts on climate change, in the physical, biological scopes. Each author has a different view of the other not agreeing with the presented parameters, the important thing is to be aware of the aspects and impacts, so that they are controlled.

Adopting the perspectives regarding the sustainability of the processes, the economic, environmental and social fields are naturally adopted, interacting so as not to compromise the environment, the paper and pulp companies can guarantee the continuity of the process.

In the observed analysis of the company, it is being structured so that the program of reduction of the impacts of climate change, through actions that cover the entire product life cycle, expects to sensitize its partners to the theme and achieve positive results for the environment.

With its increase in forest areas, by doubling the carbon absorption of the atmosphere, restoring degraded areas with native species, collaborating with social and environmental responsibilities, producing its raw material, performing integrated management of standards, managing its risks Operation. Seeking to anticipate and address the legitimate concerns of stakeholders before requiring costly mitigation measures.

6. Conclusion

Based on information provided by the Brazilian Tree Industry (IBÁ), the pulp, paper and paper artifact industries have different configurations and evolutions in the Brazilian economy.

Considering the opportunities for expansion of planted and native forests, the carbon market becomes capable of economically enhancing climatic benefits, combating climate change becomes possible, together with public policies, that will put into practice the fundamentals and principles To ease, as we have followed the evolution of the effect of GHG.

We can see our constantly changing sun causing solar storms, with monitoring constantly being made possible its prevention or mitigating measures.

According to the evaluations carried out, Fibria developed a prevention strategy in line with the recommendations of the Kyoto Protocol, the UN Conference of the Parties (COPs) and the National

Policy on Climate Change, among others, using the IDA that identifies good Practices and weaknesses related to the socio-environmental performance of the Forest area and promoting maintenance and improvements.

The company undertakes to publish its annual inventory of GHG emissions, mitigating its internal processes such as: conservation importance, recovery and sustainable management of forest resources, protection of vegetation, fauna, flora, Permanent Preservation areas and Legal Reserve areas, control of the forest exploitation taking advantage of new business opportunities and increasing its competitiveness.

Including strategic guidelines in the GHG processes and services, maintain the search for continuous reduction of specific GHG emissions and the net balance of CO₂ emissions of companies through actions of direct reduction of emissions in production processes and services.

To reduce GHG emissions, the GHG is committed to meeting the growing global demand for forest products, the Paris Agreement, contributing to global efforts by monitoring, evaluating and reviewing for integrated management.

7. References

- [1] Arroja L, Dias A C and Chapel I (2006) The role of Eucalyptus globulus Forest and products in carbon sequestration. *Climatic Change*
- [2] Ministry of Environment. Greenhouse Effect and Global Warming. Retrieved from <http://www.mma.gov.br/clima/energia/item/195-efeito-estufa-e-quequecimento-global> Accessed on: 06 May 2017
- [3] NASA Space Weather: The Space Time model simulates solar storms from nowhere. Retrieved from <https://www.nasa.gov/feature/goddard/2017/nasas-fermi-sees-gamma-rays-from-hidden-solar-flares> Accessed on: 10 May 2017
- [4] Ministry of the Environment. Report 1 Characterization of the climate in the 20th Century and Climatic Scenarios in Brazil and South America for the 21st Century derived from the Global Climate Models of the IPCC. Retrieved from http://mudancasclimaticas.cptec.inpe.br/~rmclima/pdfs/prod_probio/Relatorio_1.pdf Accessed on: 10 May 2017
- [5] CEPEA Center for Advanced Studies in Applied Economics. Brazil exports US \$ 6 billion in pulp, paper and wood panels in the first eleven months of 2016. Retrieved from <http://www.cepea.esalq.usp.br/br/categoria/acessar/informativo-florestal-1.aspx>. Accessed on: 28 feb. 2017
- [6] Exame.com. Production of Pulp in Brazil in January has an annual increase of 4.8%. Retrieved from <http://exame.abril.com.br/economia/producao-de-celulose-do-brasil-em-janeiro-to-high-annual-of-48>. Accessed on: 28 Feb. 2017
- [7] Santos G P S, Alves D F, Paiva L S and Nunes R V A (2010) Paper and paperboard chain and recycling: a comparative analysis in the packaging industry. In: National Meeting of Production Engineering, XXX, 2010, São Carlos, São Paulo
- [8] Forest Panel. The 12 countries that most produce pulp in the world. Retrieved from <http://www.painelflorestal.com.br/noticias/celulose-e-papel/os-12-maiores-produtores-de-celulose-do-mundo> Accessed on: 01 May 2017
- [9] CAIT Climate Data Explorer. Infographic: How are the emissions of your country? Retrieved from <http://www.wri.org/blog/2015/06/infographic-what-do-your-countrys-emissions-look> Accessed on: 01 May 2017
- [10] The globe. China's demand for hygiene products boosts paper exports. Retrieved from <http://oglobo.globo.com/economy/business/cambio-demanda-de-china-por-producto-de-higiene-impulsionam-exportacao-de-papel-18630424> Accessed on: Feb 28th. 2017
- [11] Exame.com. Emissions of polluting gases in Brazil fell 50% in 5 years. Retrieved from <http://exame.abril.com.br/brasil/emissoes-do-brasil-caem-50-nos-ultimos-5-anos/>. Accessed on: 28 feb. 2017

- [12] Rosa B N and Moraes G G (2005) The importance of recycling paper in improving the quality of the environment. In: National Meeting of Production Engineering - ENEGEP, Anais, 25., 2005. Porto Alegre, RS
- [13] Ministry of the Environment. Foundations for the Elaboration of the Desired Nationally Determined Contribution (iNDC) of Brazil in the context of the Paris Agreement. Retrieved from <http://www.mma.gov.br/clima/convencao-das-nacoes-unidas/acordo-de-Paris/itemlist/category/138-climate-convention-on-climate-change>. Accessed on: 28 feb. 2017
- [14] Fibria Institutional Sustainability. Retrieved from <http://www.fibria.com.br/web/pt/institucional/sustentabilidade.htm>. Accessed on: 28 feb. 2017
- [15] Fibria Environment Climate Change. Retrieved from <http://www.fibria.com.br/ambiente/mudancas-climaticas/>. Accessed on: 28 feb. 2017
- [16] Fibria Media Releases. January 31, 2017 - Fibria ends 2016 with sales growth, strong net profit and robust cash position. Retrieved from <http://www.fibria.com.br/midia/releases/fibria-encerra-2016-com-crescimento-de-vendas-forte-lucro-liquido-e-robusta-posicao-de-caixa/> Accessed on: 28 feb. 2017
- [17] Ministry of the Environment. Retrieved from <http://www.mma.gov.br/clima/adaptacao/plano-nacional-de-adaptacao> Accessed on: 28 Feb.2017
- [18] Subak S and Craighill A (1999) The contribution of the paper cycle to global warming. Mitigation and Adaption Strategies for Global Change
- [19] IBÁ Brazilian Tree Industry. Ibá certification. Retrieved from <http://iba.org/en/arvores-plants/certificacao>. Accessed on: 28 feb. 2017